PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

(Document No. RA050001 Revision M)

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THIS HANDBOOK INCLUDES THE MATERIAL REQUIRED TO BE FURNISHED TO THE PILOT BY THE FEDERAL AVIATION REGULATIONS AND ADDITIONAL INFORMATION PROVIDED BY THE MANUFACTURER, AND CONSTITUTES THE FAA APPROVED AIRPLANE FLIGHT MANUAL.

This Handbook meets GAMA Specification No. 1, *Specification for Pilot's Operating Handbook,* issued February 15, 1975 and revised September 1, 1984.

Approved by the Federal Aviation Administration

By: Lester H. Burven (Name) Title: Manager, Flight Test Branch, ANM-1605

Date: 22 Feb 00 Initial Issue: 22 Feb 00 Revised: 16 Oct 06

PILOT OPERATING HANDBOOK
LOG OF NORMAL REVISIONS

Normal Revision No.	Revised Pages	Description of Revision or Referenced Narrative Discussion Pages	Approved By Date
A/02-22-2000	Title Page	Title page changed to reflect FAA approval of Airplane Flight Manual	Jeff Morfitt 02/22/2000
B	Entire AFM/POH	The entire AFM/POH was reissued. For specific details, see the narrative discussion of revisions, which begins on page xii.	Tom Archer Acting Manager Flight Test Branch, Seattle ACO June 2, 2000
C	AFM/POH Sections 1 – 8 and Current Supplements	Between Revisions B and C an upgraded application software was installed. The new software caused minor repagination of the document, which necessitated a total reprinting of Sections 1 through 8 of the AFM/POH. In addition, all the applicable supplements were reissued. For specific details see the narrative discussion of revisions, which begins on page xii.	A.J. Pasion Manager, Special Certification Branch, Seattle Aircraft Certification Office ANM-190-S
D	Sections 3, 6, 7, and 9	All references to Standard and Premium IFR packages were removed. This change affected Section Nos. 3 and 7. The Weight and Balance Record in Section No. 6 was moved to the end of Appendix A and converted to a form, sans headers and footers. The headings in Appendix A were modified so that they are generic. All the modifications to Section No. 6 changed the pagination, and the section was reissued in its entirety. Equipment that is part of the airplane's type design was removed from Section 9 and added to Section 7. Section 9 was updated to reflect current and anticipated STC's.	A.J. Pasion Manager, Special Certification Branch, Seattle Aircraft Certification Office ANM-190-S
E	Section 2, Section 7	Added JPI and Shadin instruments to the Optional Equipment Section. Moved Optional Equipment Section after Miscellaneous Equipment Section. Added placard in Limitations section for JPI instrument. Added TLC document number to the footer of each page.	Jeff Morfitt Project Manager, Special Certification Branch, Seattle Aircraft Certification Office
F	Section 2, Section 3, Section 4, Section 6, Section 7	Section 2, changed a few dimensions and weights. Changed placard section to show actual placards. Corrected power produced in Section 3, and added special standby battery discussion. Deleted a few references to the standard package. Updated pre-flight procedure to include leading edge of horizontal and vertical stabilizer in Section 4. Changed equipment list to make "Types of Equipment for Operation" List and "Installed Equipment List". Added MX20 to Optional Equipment section. Updated baggage net description in Section 6. Updated horizontal description and added information on leading edge tape in Section 7. Corrected information about the air Hobbs switch in Section 7. Corrected digital engine scanner number. Changed information on vacuum system to reflect current design.	Jeff Morfitt Project Manager, Special Certification Branch, Seattle Aircraft Certification Office

PILOT OPERATING HANDBOOK
LOG OF NORMAL REVISIONS

Normal Revision No.	Revised Pages	Description of Revision or Referenced Narrative Discussion Pages	Approved By Date
G	AFM/POH Sections 1 – 8	Updated manual with SI units to meet Canadian requirements. Added new equipment including GPSS, ground power plug, aural warning. Updated checklists. Added missing information and corrected existing information throughout the manual.	Jeff Morfitt Project Manager, Special Certification Branch, Seattle Aircraft Certification Office
H	AFM/POH Section 7	Removed note from aural warning section that stated the system was not yet certified.	Jeff Morfitt Project Manager, Special Certification Branch, Seattle Aircraft Certification Office
I	AFM/POH Sections 1 – 8	Added missing information and corrected existing information throughout the manual.	N/A
J	AFM/POH Sections 1, 2, 3, 4, 6, 7	Incorporated FAA comments. Added missing information and corrected existing information throughout the manual.	Jeff Morfitt Project Manager, Special Certification Branch, Seattle Aircraft Certification Office
K	AFM/POH Sections 4, 5, 6, 7	Added information about pitot heat in Section 4. Added new airspeed calibration graphs in Section 5. Other clerical corrections in Sections 6 and 7.	Jeff Morfitt Project Manager, Special Certification Branch, Seattle Aircraft Certification Office
L	AFM/POH Sections 1, 2, 3, 5, 6, 7, and 8	See Narrative Discussion of Revisions. This POH/AFM revision provides a terminating action for AD# 2005-CE-01-AD.	E.P.Kolano Flight Test Branch Seattle Aircraft Certification Office 5/10/05
M	AFM/POH Sections 1, 2, 3, 4, 5, 6, 7, and 8	See Narrative Discussion of Revisions.	Shaun Ripple Flight Test Branch Seattle Aircraft Certification Office 21 Nov 2006

PILOT OPERATING HANDBOOK
LOG OF TEMPORARY REVISIONS

Temporary Revision No. and Date	Revised Pages	Description of Revision or Referenced Narrative Discussion Pages	Approved By Date

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LIST OF EFFECTIVE PAGES					
Reissue		Added Pages			
Page	Rev	Page	Rev	Page	Rev
INTRODUCTION PAGES					
Title	M				
ii	M				
iii	M				
iv	M				
v	M				
vi	M				
vii	M				
viii	M				
ix	M				
x	M				
xi	M				
xii	M				
xiii	M				
xiv	M				
xv	M				
xvi	M				
xvii	M				
xviii	M				
xix	M				
xx	M				
xxi	M				
xxii	M				
SECTION 1 (General)					
1-1	I				
1-2	I				
1-3	G				
1-4	M				
1-5	G				
1-6	I				
1-7	I				
1-8	L				
1-9	I				
1-10	I				

LIST OF EFFECTIVE PAGES					
Reissue		Added Pages			
Page	Rev	Page	Rev	Page	Rev
1-11	I				
1-12	I				
1-13	G				
1-14	G				
1-15	C				
1-16	C				
1-17	C				
1-18	C				
1-19	I				
1-20	I				
1-21	I				
1-22	I				
1-23	I				
1-24	I				
SECTION 2 (Limitations)					
2-1	M				
2-2	G				
2-3	C				
2-4	M				
2-5	G				
2-6	M				
2-7	G				
2-8	G				
2-9	G				
2-10	J				
2-11	J				
2-12	J				
2-13	J				
2-14	J				
2-15	J				
2-16	J				
2-17	J				
2-18	J				
2-19	J				

LIST OF EFFECTIVE PAGES					
Reissue		Added Pages			
Page	Rev	Page	Rev	Page	Rev
2-20	J				
SECTION 3 (Emergency Procedures)					
3-1	M				
3-2	M				
3-3	I				
3-4	I				
3-5	I				
3-6	I				
3-7	I				
3-8	I				
3-9	I				
3-10	I				
3-11	I				
3-12	L				
3-13	D				
3-14	G				
3-15	F				
3-16	C				
3-17	C				
3-18	I				
3-19	I				
3-20	I				
3-21	I				
3-22	I				
3-23	M				
3-24	M				
3-25	M				
3-26	M				
3-27	M				
3-28	M				
SECTION 4 (Normal Procedures)					
4-1	M				
4-2	M				
4-3	G				

LIST OF EFFECTIVE PAGES					
Reissue		Added Pages			
Page	Rev	Page	Rev	Page	Rev
4-4	G				
4-5	K				
4-6	M				
4-7	M				
4-8	M				
4-9	M				
4-10	M				
4-11	M				
4-12	M				
4-13	I				
4-14	I				
4-15	I				
4-16	I				
4-17	I				
4-18	I				
4-19	I				
4-20	I				
4-21	I				
4-22	M				
4-23	M				
4-24	M				
4-25	M				
4-26	M				
4-27	M				
4-28	K				
SECTION 5 (Performance)					
5-1	C				
5-2	C				
5-3	K				
5-4	K				
5-5	K				
5-6	K				
5-7	M				
5-8	G				

LIST OF EFFECTIVE PAGES					
Reissue		**Added Pages**			
Page	**Rev**	**Page**	**Rev**	**Page**	**Rev**
5-9	G				
5-10	G				
5-11	G				
5-12	G				
5-13	I				
5-14	I				
5-15	I				
5-16	I				
5-17	I				
5-18	I				
5-19	G				
5-20	G				
5-21	G				
5-22	I				
5-23	I				
5-24	I				
5-25	G				
5-26	G				
SECTION 6 (Weight & Balance)					
6-1	M	6-19	M		
6-2	G	6-20	M		
6-3	G				
6-4	M				
6-5	M				
6-6	M				
6-7	M				
6-8	M				
6-9	M				
6-10	M				
6-11	M				
6-12	M				
6-13	M				
6-14	M				
6-15	M				

LIST OF EFFECTIVE PAGES					
Reissue		**Added Pages**			
Page	**Rev**	**Page**	**Rev**	**Page**	**Rev**
6-16	M				
6-17	M				
6-18	M				
Weight & Balance (Appendix A) **Type of Equipment for Operation List**					
6-A1	M				
6-A2	M				
6-A3	M				
6-A4	M				
6-A5	M				
6-A6	M				
6-A7	M				
6-A8	M				
Weight & Balance (Appendix B) **Installed Equipment List**					
6-B1	M				
6-B2	M				
6-B3	M				
6-B4	M				
6-B5	M				
6-B6	M				
SECTION 7 **(Description of Airplane & Systems)**					
7-1	I	7-79	M		
7-2	I	7-80	M		
7-3	I				
7-4	M				
7-5	M				
7-6	M				
7-7	I				
7-8	I				
7-9	I				
7-10	I				
7-11	L				
7-12	J				

LIST OF EFFECTIVE PAGES					
Reissue		Added Pages			
Page	Rev	Page	Rev	Page	Rev
7-13	M				
7-14	L				
7-15	I				
7-16	I				
7-17	I				
7-18	I				
7-19	M				
7-20	M				
7-21	I				
7-22	I				
7-23	I				
7-24	I				
7-25	I				
7-26	I				
7-27	I				
7-28	I				
7-29	I				
7-30	I				
7-31	I				
7-32	I				
7-33	I				
7-34	J				
7-35	I				
7-36	I				
7-37	I				
7-38	I				
7-39	I				
7-40	I				
7-41	I				
7-42	I				
7-43	I				
7-44	I				
7-45	I				
7-46	I				

LIST OF EFFECTIVE PAGES					
Reissue		Added Pages			
Page	Rev	Page	Rev	Page	Rev
7-47	I				
7-48	I				
7-49	I				
7-50	I				
7-51	I				
7-52	I				
7-53	I				
7-54	I				
7-55	L				
7-56	L				
7-57	M				
7-58	M				
7-59	M				
7-60	M				
7-61	M				
7-62	M				
7-63	M				
7-64	M				
7-65	M				
7-66	M				
7-67	M				
7-68	M				
7-69	M				
7-70	M				
7-71	M				
7-72	M				
7-73	M				
7-74	M				
7-75	M				
7-76	M				
7-77	M				
7-78	M				

LIST OF EFFECTIVE PAGES					
Reissue		**Added Pages**			
Page	**Rev**	**Page**	**Rev**	**Page**	**Rev**
SECTION 8 (Handling, Servicing & Maintenance)					
8-1	G				
8-2	G				
8-3	L				
8-4	G				
8-5	G				
8-6	G				
8-7	G				
8-8	M				
8-9	G				
8-10	G				
8-11	I				
8-12	I				
8-13	I				
8-14	I				
8-15	I				
8-16	I				
8-17	I				
8-18	I				
8-19	I				
8-20	I				
SECTION 9 (Supplements) **SUPPLEMENTS 1 - 13** There are 13 supplemental sections appended to Section 9. Page 3 in each supplement contains a table of revisions that provides the effective date of each page.					
9-1	C				
9-2	C				
9-3	C				
9-4	C				

NARRATIVE DISCUSSION OF REVISIONS		
Revision Level	**Page No.**	**Comment**
A	Cover	The cover page was modified to incorporate the date FAA dated and signed copy.
B	Various	The entire AFM/POH is being reissued with revision B. This procedure was anticipated since actual use of the documentation during flight and ground-training operations will always uncover a number of mistakes and oversights. There were approximately 80 typographical and grammatical errors. The most frequent was the use of a comma before the conjunctive adverb ***however*** instead of a semicolon. Other items included: subject-verb agreement; an omitted or extra article, helping verb, conjunction, or preposition; omitted or unnecessary ***ed***, ***ly*** etc. endings of a word, i.e., ***recommend*** instead of ***recommended*** or ***turned*** instead of ***turn***, are typical examples; in a few instances, a word was plural when it should be singular and visa-versa, i.e., ***doors seal*** instead of ***door seals*** or ***controls*** instead of ***control***; a few unnecessary commas were removed and a few missing periods were added; in a few areas there was reference to the next table when actually it was the previous table and visa-versa; of course, there were a few misspelled words, i.e., **sale weight** was used for **scale weight** and **lightening** was used for **lightning**; there were about 10 incidents where an unnecessary space was added to the airplane's designation, i.e., LC 40-550FG, which was removed; there were a few areas where double line-spacing between paragraphs and an unnecessary line space after a heading were removed. None of the above revisions affected the meaning of what was written. The entire AFM/POH was converted to PDF format. This procedure simplifies printing as well as the revision process; however, the PDF format does change the pagination of the document slightly. The net effect was that Section 4 now contains 26 pages, rather than 28 pages. In addition, the positioning of text on the various pages may vary slightly from revision A. The page numbers cited in column 2 refer to the pages of revision B.
B	viii	Under Section 4 pages 4-27 and 4-28 were removed from the list of effective pages.
B	1-4	**Propeller –** The low and high pitch stop settings were revised to 13.5º and 35º, respectively.
B	1-5	**Specific Loading** – The power loading was revised to read 10.97.
B	1-13	The entire page was revised extensively to reflect current procedures and designations.
B	2-4	**Powerplant Limitations** – Maximum recommended cruise BHP was changed to 248.
B	2-6	**Propeller Data and Limitations** – The low pitch stop setting was changed to 13.5º.
B	3-6	**Engine Failure . . . (Below 400 feet AGL)** – Item 1, both airspeeds were changed to 90 KIAS.
B	3-10	**In-Flight Engine Fire** – Turning off HVAC was moved to occur before turning off the master switch. The airspeed in item 6 was changed to 179 KIAS.
B	3-10	**In-Flight Electrical Fire** – These procedures were extensively revised. HVAC was moved to item 1. Item 7 was removed. The remaining items were changed to use the standby battery for a phased power up.
B	3-10	**In-Flight Cabin Fire (Fuel/Hydraulic Fluid)** – Turning off HVAC was moved to item 1.
B	3-23	**Failure of engine driven fuel pump –** The paragraph was made less ambiguous by adding adjectives to the word *pump*, i.e., *backup* pump, pump *arming*, etc.
B	3-29	**Exterior Emergency Exit Release** – No. 6 was added to the narrative discussion, which makes it more similar to the placarded instructions.
B	4-1	**Preflight Inspection Area 1** – In item 7 the word *right* replaces the word *left*.
B	4-8	**Before Takeoff –** Item 5 is expanded to ensure the HSI is in the slave mode.
B	4-10	**Cruise** – Item 5 was altered to *Changing Fuel Tanks* followed by two subheadings.
B	4-10	The two *Notes* on the page were consolidated under one heading, but kept separate.
B	4-21	**Mixture Settings –** The use of the words warmer and colder in relation to EGT adjustments was confusing. These words were dropped in favor of richer and leaner.

NARRATIVE DISCUSSION OF REVISIONS		
Revision Level	**Page No.**	**Comment**
B	4-24	**Warning** – The words *Federal Aviation Agency* were replaced with *FAA*, which was done for spacing purposes.
B	4-25	**Caution** – The caution statement was moved up one paragraph for spacing purposes.
B	5-20	**Figure 5-21** – The far right text box was changed to 50% rather than 60%.
B	6-9	The CG, empty weight, and related numbers in the sample problem were changed to parallel those of the certified airplane rather than the prototype.
B	6-17 & 6-18	The sample problem was changed to incorporate the revised empty weight and CG on page 6-9.
B	6-20 & 6-21	The headings and labeling of the four multiplying graphs on these pages were formatted with similar fonts and centered more precisely. All changes were cosmetic in nature.
B	6-A2	**21-07** – An operational ECS servomotor was made a requirement for all flight conditions.
B	7-13	**Wing Flaps** – The dimmer wheel no longer controls the illumination of the flap EL lighting and the second paragraph was so modified.
B	7-19	**Propeller and Governor** – In the third paragraph the low pitch stop setting was changed to 13.5º.
B	7-28	**KI 256 Flight Director (FD)** – Second paragraph, last sentence, the words *portion of this POH/AFM* were removed.
B	7-39	**Figure 7-10** – Equipment available on the standby battery was modified to include the GPS for the premium IFR package.
B	7-41	**Upper Engine and Instrument Panel** – The text was modified to indicate that the **left** thumb-wheel controls the lights.
B	7-41	**Lower Instrument Panel, Circuit Breaker Panel and Rocker Switches** – The text was modified to indicate that the **right** thumb-wheel controls the lights.
B	7-42	**Figure 7-12 Upper Instrument Panel row** – Text in the center cell was modified to indicate that the **left** thumb-wheel controls the lights.
B	7-42	**Figure 7-12 Lower Inst. & Circuit Breaker Panel row** – Text in the center cell was modified to indicate that the **right** thumb-wheel controls the lights.
B	7-59	**Code and Altitude Display Windows** – The text was changed to reflect that the altitude display information is on the right side of the unit.
B	8-4	**Delivery Package** – In the table of items, the term *1 Set* was added after Checklist Booklet.
B	3 of 8	**Supplement No**. 4 – The revision log was revised to parallel the list of effective pages format.
B	3 of 16	**Supplement No**. **5** – The revision log was revised to parallel the list of effective pages format.
B	3 of 8	**Supplement No. 6** – The revision log was revised to parallel the list of effective pages format.
B	3 of 8	**Supplement No**. **7** – The revision log was revised to parallel the list of effective pages format.
B	3 of 6	**Supplement No**. **10** – The revision log was revised to parallel the list of effective pages format.
B	3 of 6	**Supplement No**. **11** – The revision log was revised to parallel the list of effective pages format.
C	Various	**Grammatical Corrections** – Revision C has several grammatical corrections. None of the changes affect the meaning of the text. A few hyphens, semicolons, commas, and periods were added. Noun-verb tense relationships were corrected in a few areas, and several sentences were reworded to eliminate the passive voice. Finally, the font sizes in a few areas were modified slightly because of problems with the application software.

NARRATIVE DISCUSSION OF REVISIONS		
Revision Level	**Page No.**	**Comment**
C	iii to xii	**Pilot's Operating Handbook Log of Normal Revisions –** Pages v and vi were removed. These pages were intended to accommodate future revisions; however, it would take many years to fill these pages, and they will be added when needed. The document repagination caused minor changes in the length of some section, and the List of Effective Pages (LOEP) were modified accordingly. Finally, the heading in column 1 in the LOEP was modified slightly.
C	1-11	A new heading titled *Miscellaneous* was added and the definitions of *Flight Time* and *Time in Service* were inserted.
C	1-16, 1-17 & 1-19 to 1-21	**Table Footnote** – As originally written the footnote stated, ***Example:*** *Refer to (Figure 1-1) and (Figure 1-2) for examples of how to use these types of tables*. The text was modified to state, ***Example:*** *Refer to (Figure 1-2) and (Figure 1-3) for examples of how to use these types of tables*.
C	2-5	**Fuel Flow and Fuel Pressure/Figure 2-6** – The maximum fuel flow is changed to 28 GPH and the maximum pressure is now 22 psi. These limitations parallel the new gauge placards, which were changed to reflect the expanded limitations. There were previous issues concerning noise limitations and the engine's rated horsepower. The new limits reflect full takeoff power as 2700 RPM and 310 BHP.
C	2-8	**Other Limitations (Altitude) –** The requirement for oxygen above 14,000 MSL was modified to indicate that any installed oxygen system must be FAA approved**.**
C	2-11	**Compass Card Placard** – Text was changed to indicate that strobe lights are also operated when the compass is calibrated. The statement regarding maximum deviation was removed.
C	2-13	*MAX TURN LIMIT* and *TURN LIMIT* placards were added at the bottom of the page.
C	3-6	**Precautionary Landing with Engine Power –** Removed item No. 7 (Ignition Switch – SET TO OFF) since it is in the checklist as the next to last item.
C	3-7	**Engine Fire on the Ground During Startup** – Item No. 4 had the parenthetical statement *If parking brake is engaged* added.
C	3-9	**Warning** – A warning statement was added that indicates the pilot should turn on the pitot heat at least five minutes before entering visible moisture.
C	3-10	**Electrical System Discharging** – The end of the sentence in Item No. 8 was changed to read *as possible or practicable*.
C	3-13	**(Figure 3-2)** – A reference dagger was added to the turn coordinator that indicates the circuit breaker is shared with the ECS servomotor.
C	4-7	**Before Taxi –** *HSI – SET TO THE SLAVED POSITION* was added to the checklist as Item 4. Doing this permits checking the HSI while taxiing.
C	4-7	**Taxing** – Item No. 3 was changed from *Directional Gyro* to *Directional Gyro/HSI*.
C	4-8	**Normal Takeoff** – *Landing/Taxi Lights – OFF OR AS REQUIRED* was added to the checklist as item 7.
C	4-9	**Normal Climb and Max perform climb checklist –** The landing/taxi light procedure was moved to the Normal Takeoff Checklist. Arming the backup boost pump was added to both checklists. The leaning procedure for maximum performance was expanded slightly.
C	5-25	**Sample Problem –** The solution for No. 4 was changed from 6.1 Miles to 8.5 Miles.
C	5-26	**Sample Problem –** The solutions for Nos. 11 and 12 were reversed. This was corrected, and the word "feet" was added.
C	6-17	**Figure 6-17** – A note was added that reminds the user that the sample empty weight will vary for each airplane, and an appropriate reference is provided that shows the location of the actual empty weight.
C	7-14	**Front Seat Adjustment** – Clarified the procedure for manual adjustment of the seats.
C	7-22	**Manifold Pressure and Fuel Flow/Fuel Pressure** – The location of these instruments was changed from center-right to upper-right.
C	7-23	**Tachometer** – The location of this instrument was changed from top-right to center-right.

NARRATIVE DISCUSSION OF REVISIONS		
Revision Level	**Page No.**	**Comment**
C	7-25	**The Flight Time Mode** – The text clarified times flight timer will operate, i.e., when oil pressure exists and the system master is on; aircraft serial number applicability was also noted.
C	7-30	**Hour Meter** – A discussion of the hour meter was added on this page, which includes the two types of possible systems that could be installed. In addition, aircraft serial number applicability was also noted.
C	7-61	**Autopilot Disconnect Switch** – The text and related figure were modified to eliminate all references to Control Wheel Steering (CWS).
C	8-7	**Tire Considerations** – This heading and related discussion was added to the AFM/POH. In addition, a caution statement was inserted after the text.
C	8-7	**Dipstick NOTE** – Text was added explaining how to remove the dipstick.
C	8-8	**Battery Replacement Cycles** – A new heading with related information was added.
C	6 of 8	**Supplement No. 4** – All reference to control wheel steering (CWS) was removed.
C	Various	**Supplement No. 5** – The term DTA was changed to DAT.
D	Various	Revision D has a few grammatical corrections. None of the changes affect the meaning of the text. A few hyphens, semicolons, commas, and periods were added. Noun-verb tense relationships were corrected in a few areas, and a few sentences were reworded to eliminate the passive voice.
D	3-13	The reference to Premium IFR Package was removed from Figure 3-2.
D	3-23	Reference to the Premium IFR Package was removed from Figure 3-5. This changed the pagination of the remaining pages.
D	Whole Section	The Weight and Balance Record in Section No. 6 was moved to the end of Appendix A and converted to a form, sans headers and footers. All references to the Weight and Balance form were updated. The headings in Appendix A were modified so that they are generic. In addition, all references to the Premium and Standard IFR Packages were removed. All the modifications to Section No. 6 changed the pagination, and the section was reissued in its entirety.
D	7-27	Discussion of the Integrated Flight System was added.
D	7-28 to 7-29	The discussion of the KI 256 attitude indicator and flight director was moved from Section 9 to these pages, and previous references to the basic attitude indicator were removed. A discussion of the autopilot/flight director interface was added.
D	7-30 to 7-31	The discussion of the KCS 55A Compass System was moved from Section 9 to these pages, and previous references to the basic directional gyro (DG) were removed.
D	7-46 to 7-56	All reference to the Premium and Standard IFR Packages were removed, which included: (1) Removal of the GX60 GPS graphic and all references to the GX60 GPS. (2) A slightly modified discussion of theMD-200.
D	7-62 to 7-63	**Optional Equipment** – This is a new subsection of Section 7. The discussion of the AvroTec FlightMonitor and the BF Goodrich 500/950 Stormscopes were added to this section.
E	7-62 to 7-70	The Optional Equipment section was moved so that it now comes after the Miscellaneous Equipment Section.
E	7-66 and 2-11	Added information about the J.P. Instruments digital engine scanner to the Optional Equipment Section. Added placard for digital engine scanner to the Limitations section.
E	7-67 to 7-70	Added information about the Shadin fuel flow management system to the Optional Equipment Section.
F	2-5	Correct baggage and entry dimensions and changed standard empty weight and useful load.

NARRATIVE DISCUSSION OF REVISIONS		
Revision Level	**Page No.**	**Comment**
F	2-9 to 2-17	Replaced all placard descriptions with pictures of placards.
F	3-13 to 3-16	Corrected the percent BHP the aircraft produces.
F	3-23 to 3-28	Add special information for the standby battery. Removed of few lingering references to vacuum driven directional gyro.
F	4-3 to 4-12	Added step to check leading edge of horizontal and vertical stabilizers during pre-flight. Change "ON" to "SET TO ALT" on the before takeoff checklist.
F	6-1 to 6-2	Updated Table of Contents for Chapter 6.
F	6-11 to 6-14	Updated information about the baggage nets.
F	6-A1 to 6-A8	Changed the title of the equipment list to "Types of Equipment for Operation". Removed the weight and arm information. Moved the sheet titled *Tabulated After-Market Equipment List* to the end of the section, just before the *Weight and Balance Record*.
F	6-B1 to 6-B4	Added "Installed Equipment List" that will be updated for each delivered aircraft and lists the weight and arm information. This list was also given a separate appendix, i.e. Appendix B. The list is printed in landscape for consistency of presentation.
F	7-1 to 7-6	Updated Table of Contents for Chapter 7.
F	7-7 to 7-12	Added information about the horizontal stabilizer, and added information about leading edge tape.
F	7-22 & 7-24	Added admonition to remind the pilot that the fuel gauges are approximate indications and are never substitutes for proper planning and pilot technique.
F	7-21 to 7-34	Added information to assure that flight is only allowed when both vacuum pumps are operating. Changed vacuum drawing and text to reflect current design.
F	7-35	Updated fuel system diagram to include the optional Shadin fuel flow meter.
F	7-40 to 7-45	Updated information on the rudder limiter.
F	7-66	Corrected digital engine scanner number to EDM-701.
F	7-70 to 7-72	Added information about the MX20 multi-function displays.
G	1-2	Added SI units.
G	1-3	Added note that U.S. operating rules do not apply in Canada.
G	1-4	Added SI units.
G	1-13 to 1-14	Updated page and figure references.
G	2-1	Modified Table of Contents for Chapter to add Electronic Display Limitations
G	2-4 to 2-8	Added SI units.
G	2-5	Modified Powerplant Limitations to clarify that there is a red line below zero on the fuel quantity gauge and there is a red line at 10 psi on the oil pressure gauge.
G	2-8	Added Electronic Display Limitations to discuss MX20 limitations. Added note that U.S. operating rules do not apply in Canada.
G	2-9	Updated page and figure references.
G	2-14 to 2-16	Added oil filler placard, fuel filler placard, and ground power plug placard.
G	3-3	Added SI units.
G	3-7	Updated page and figure references.
G	3-9	Updated page and figure references.

NARRATIVE DISCUSSION OF REVISIONS		
Revision Level	**Page No.**	**Comment**
G	3-12	Updated page and figure references.
G	3-14	Added SI units.
G	3-18 to 3-19	Added SI units. Updated page and figure references.
G	4-1 to 4-2	Updated Table of Contents
G	4-3	Added SI units. Changed crosswind component to 23 knots.
G	4-4 to 4-12	Updated checklists.
G	4-6 to 4-7	Added "Engine Start with Ground Power Cart" and "After Engine Start with Ground Power Cart" checklists.
G	4-8	Added step to the Before Takeoff Checklist to check that doors are latched and detented. Added steps for testing the aural warning system.
G	4-10	Added SI units. Updated page and figure references.
G	4-13	Updated page and figure references.
G	4-14 to 4-16	Added SI units. Updated page and figure references.
G	4-17	Added information about taxiing with the doors open to the Taxiing section. Added note that U.S. operating rules do not apply in Canada.
G	4-19	Updated page and figure references.
G	4-22	Updated page and figure references.
G	4-25	Added SI units.
G	4-27	Added note that U.S. operating rules do not apply in Canada. Added SI units.
G	5-6	Added SI units. Updated page and figure references.
G	5-8 to 5-22	Added SI units. Updated page and figure references.
G	5-25	Added SI units.
G	6-3	Added note that U.S. operating rules do not apply in Canada.
G	6-A1	Changed Title to Equipment for Types of Operation
G	6-A1 to 6A8	Renumbered and added additional equipment to list.
G	6-B1	Changed Installed Equipment List so that the title, S/N, and N-Number is on each page.
G	6-B1 to 6B5	Renumbered and added additional equipment to list.
G	7-10 to 7-12	Updated page and figure references.
G	7-13	Added explanation that the flap extended light will continue to blink until the airspeed is below 100 knots.
G	7-15	Added information about taxiing with the doors open to the Door section.
G	7-17	Added section on optional handles.
G	7-20	Added SI units.
G	7-22	Updated page and figure references.
G	7-24	Added Aural Warning section. Updated page and figure references.
G	7-26	Added information to the digital clock operation that the flight timer will not work unless SL is incorporated.
G	7-28 to 7-30	Updated page and figure references.
G	7-33	Updated page and figure references.

NARRATIVE DISCUSSION OF REVISIONS		
Revision Level	**Page No.**	**Comment**
G	7-37	Clarified that increasing the fan speed will not increase flow through the eyeball vents. Added SI units.
G	7-42 to 7-43	Added SI units. Updated page and figure references.
G	7-54	Updated page and figure references.
G	7-57 to 7-58	Updated page and figure references.
G	7-61	Updated page and figure references.
G	7-62	Added note that U.S. operating rules do not apply in Canada.
G	7-64	Added note that U.S. operating rules do not apply in Canada.
G	7-65	Updated page and figure references.
G	7-68	Updated page and figure references.
G	7-71 to 7-72	Added information regarding the operation of the MX20 system. Updated page and figure references.
G	7-72	Added section on the Ground Power Plug.
G	7-73	Added section on the S-Tec 429 Global Positioning Steering System (GPSS) Converter.
G	8-1 to 8-2	Updated Table of Contents.
G	8-3	Added note that U.S. operating rules do not apply in Canada.
G	8-4 to 8-5	Added SI units.
G	8-7	Added SI units.
G	8-8	Updated page and figure references.
G	8-9	Added note that U.S. operating rules do not apply in Canada. Added SI units.
G	8-17	Added section on the care of anti-erosion tape.
H	7-25 to 7-26	Removed note on aural warning that stated the system was not certified.
H	6-A21	Changed description to Aural Warning System
H	6-B2	Changed description to Aural Warning System
I	i - xx	Updated
I	1-1	Updated Chapter 1 TOC
I	1-2	Updated three-view drawing to more accurately depict aircraft.
I	1-7	Corrected ISA temperature. Was: 56.5ºC Is: -56.5ºC.
I	1-18	Corrected table to call out nautical miles instead of knots.
I	2-12	Added new compass placard design. Changed term “escape hatchet” to “crash ax” for consistency throughout manual.
I	3-1 to 3-2	Updated Chapter 3 TOC.
I	3-8	Changed reference in In-flight Engine Fire checklist.
I	3-8	Changed Step 6 of the In-flight Cabin Fire Checklist to say “Follow Emergency Landing without Engine Power” checklist.”
I	3-19	Clarified the rudder deflection in the “Malfunction” section: is 17º ± 1º to 11.5º ± 0.5º.
I	3-20	Added “Lightning Strike” section.
I	3-29	Added description to strike the “corner” edge of the window when using the crash ax.
I	4-1 to 4-2	Updated Chapter 4 TOC

NARRATIVE DISCUSSION OF REVISIONS		
Revision Level	**Page No.**	**Comment**
I	4-6	Added Caution note that the master switch should not be turned on until after the engine has started and the ground power plug has been removed. Updated "Starting Engine with Ground Power Cart" checklist to remove step to turn on master switch.
I	4-13	Corrected description of Aileron servo tab section.
I	4-19	Rewrote "Door Seals" section.
I	5-13	Corrected typo in table.
I	5-14	Corrected manifold pressure at 2700 RPM to read 21.
I	5-16	Corrected -38 sub-heading. Was: 23 C Is: 33 C.
I	5-17	Corrected fuel flow at the -9 standard temperature, 2300 RPM, 17" mp, 46% bhp to read 8.4 gph.
I	5-22	Corrected equation in example to read: (57 – 18 = 39).
I	5-23	Reformatted figures.
I	5-24	Reformatted figures
I	6-A1	Added note explaining that chapter numbers correspond to the MM chapter numbers.
I	6-A2	Corrected drawing number for item 23-05.
I	6-A7	Changed drawing number to N/A for items 34-40 and 34-41.
I	6-B4 to 6-B5	Changed drawing number to N/A for items 34-40 and 34-41.
I	7-1 to 7-6	Updated Chapter 7 TOC.
I	7-8	Removed reference that anti-erosion tape can only be installed on aircraft S/N 40010 and on.
I	7-10	Clarified the rudder deflection in Rudder Limiter section to 17º ± 1º to 11.5º ± 0.5º.
I	7-11	Corrected the Simultaneous Trim Application to note that if the pilot's and co-pilot's trim are moved in opposite directions, the pilot's overrides the co-pilot's.
I	7-16	Added function of the aural warning system to the "Latching Mechanism" section.
I	7-35	Added S/N's to title of Fuel System Diagram. Added new picture of fuel system diagram for aircraft S/N 40080 and on. Added S/N's to Fuel Vent system and added second Fuel Vent System section for aircraft S/N 40080 and on.
I	7-37	Clarified procedures for moving the fuel selector valve.
I	7-47	Clarified the rudder deflection in Rudder Limiter section to 17º ± 1º to 11.5º ± 0.5º.
I	7-55	Corrected APR to APPR, which is what is displayed on the ACU.
I	7-58	Corrected typos on page.
I	7-64	Removed reference to SL30 in ADS Section. Added note that using the elevator trim switch should not be used in lieu of using the ADS.
I	7-83	Added Caution note that the master switch should not be turned on until after the engine has started and the ground power plug has been removed.
I	8-12	Added Warning about eyebolts to the "Securing the Airplane" section.
I	8-17	Updated "Anti-erosion Tape" section to include tape on gear fairings.
J	2-11	Added two new interior placards.
J	3-1/3-2	Updated TOC.
J	4-1/4-2	Updated TOC.
J	6-A4	Removed individual wheel, brake, tire, and tube assemblies for the main gear leaving the complete assemblies. Added nose gear assembly. Changed order of Chapter 32 items.
J	6-B2	Removed individual wheel, brake, tire, and tube assemblies for the main gear leaving the complete assemblies. Added nose gear assembly. Changed order of Chapter 32 items.
J	6-B5	Corrected arm of portable oxygen system to 133.0.

NARRATIVE DISCUSSION OF REVISIONS		
Revision Level	**Page No.**	**Comment**
J	7-12	Corrected diagram to accurately depict Items A through K.
J	7-34	Changed term “suction pumps” to “vacuum pumps”.
K	4-9	Added Caution note about pitot heat operation to the Before Takeoff checklist.
K	4-26	Added information about pitot heat operation to Cold Weather Operations section.
K	5-3	Corrected Figures 5-1, 5-2, and 5-3.
K	5-5	Corrected Figure 5-5.
K	6-14	Corrected baggage moment in Figure 6-13.
K	7-16	Added reference to aural warning system to Baggage Door section.
L	1-8	Revised terminology definition for Stall Strip.
L	2-1	Revised Table of Contents.
L	3-12	Reformatted Circuit Breaker Panel paragraph
L	5-7	Revised Figure 5-7.
L	6-17	Moved the Y-axis label on Figure 6-19.
L	7-11	Revised Trim Position Indicator paragraph.
L	7-14	Reformatted Seat Belts and Shoulder Harnesses paragraph.
L	7-55	Deleted “Warning” note regarding ILS/DME approaches.
L	8-3	Revised product support e-mail address.
M	Title Page, v, viii to xxii	Revised and updated pages.
M	1-4	Revised the low pitch and high pitch setting values in the Propeller section.
M	2-1	Revised footer.
M	2-4	Deleted Maximum Manifold Pressure for Idle.
M	2-6	Revised the low pitch and high pitch setting values in the Propeller Data and Limitations section. Revised the Maximum Empty Weight from 2580 lbs. to 2568 lbs.
M	3-1 and 3-2	Revised Table of Contents.
M	3-12 and 3-13	Added Something Stuck in or Interfering With a Doorjamb checklist.
M	3-23 to 3-28	Repaginated pages. Deleted pages 3-29 an 3-30.
M	4-1 and 4-2	Revised Table of Contents.
M	4-6 through 4-12	Revised title of starting engine procedure to “STARTING COLD ENGINE.” Added Starting Hot Engine procedure.Added Approach procedure. Added Note to the Crosswind Operations section. Repaginated following pages.
M	4-22 through 4-27	Added paragraph directing fuel pump switch be off for descent and landing in the Descent section. Added paragraph to the Crosswind Landings section indicating airspeed may be up to 5 kts higher or lower than indicated during sideslipping. Repaginated following pages.
M	5-7	Replaced Figure 5-7.

NARRATIVE DISCUSSION OF REVISIONS		
Revision Level	**Page No.**	**Comment**
M	6-1	Revised Table of Contents.
M	6-4 to 6-20	Added Caution and example regarding specific weight of Aviation Gasoline. Revised Figure 6-19 and Figure 6-20. Deleted indication of an optional restraint system from the Baggage Nets section. Revised the Maximum Empty Weight section. Revised Figure 6-20. Repaginated pages and added pages 6-19 and 6-20.
M	6A	Replaced list.
M	6B	Replaced list.
M	7-4 to 7-6	Revised Table of Contents.
M	7-13	Revised main gear tire size.
M	7-15 to 7-17	Added Warning to the Door section. DO NOT open door during flight.
M	7-19	Changed 13.5º to 14º and revised the last two sentences of the third paragraph in the Propeller and Governor paragraphs.
M	7-20	Changed “or pressure is above 18 psi” to “or a pressure differntial greater than 18 psi is detected” in the Engine Oil section.
M	7-57 to 7-80	Revised the Emergency Locator Transmitter (ELT) section to include the Artex ME406 ELT. Added location of parallel port cable for chart updates of the FMP300 Flightmonitor to the Subscription paragraph. Repaginated pages.
M	8-3	Changed “Lancair Company” to “Columbia Aircraft Manufacturing Corporation”. Revised product support e-mail address.
M	8-8	Revised Figure 8-2. Revised Figure 8-3.

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Section 1
General

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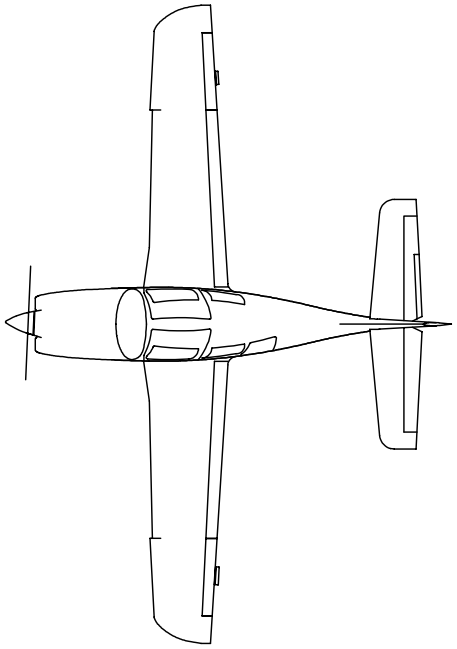
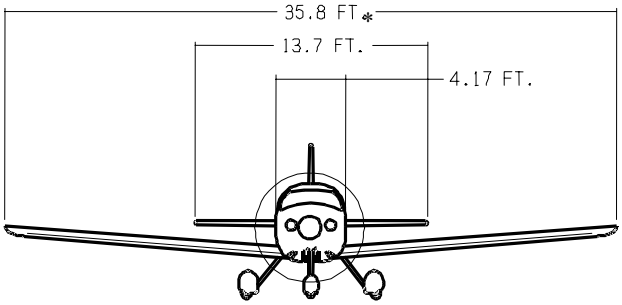
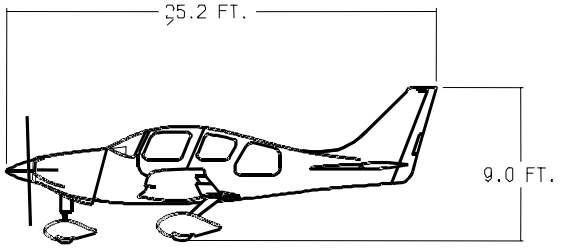
THREE-VIEW DRAWING OF THE AIRPLANE

SPECIFICATIONS	
Wing Area	141.2 ft.^{2} (13.1 m^2)
Wing Span	35.8 ft. (10.9 m)
Length	25.2 ft. (7.68 m)
Empty Weight (±)	2200 lbs. (997.7 kg)
Gross Weight	3400 lbs. (1542 kg)
Stall Speed	57 KIAS
Maneuvering Speed	148 KIAS
Cruising Speed	190 KTAS
Never Exceed Speed	235 KIAS
Engine	310 HP Continental IO-550-N
Propeller	Hartzell 77 in. (196 cm) Constant Speed
Governor	McCauley

*Note: Wingspan is 36 ft.± with position lights.







(Figure 1-1)

Section 1
General

INTRODUCTION

This handbook is written in nine sections and includes the material required to be furnished to the pilot by Federal Aviation Regulations and additional information provided by the manufacturer and constitutes the *FAA Approved Airplane Flight Manual*. Section 1 contains generalized descriptive data about the airplane including dimensions, fuel and oil capacities, and certificated weights. There are also definitions and explanations of symbols, abbreviations, and commonly used terminology for this airplane. Finally, conventions specific to this manual are detailed.

NOTE

Federal Aviation Regulations require that a current Handbook be in the airplane during flight. (U.S. operating rules do not apply in Canada.) It is the operator's responsibility to maintain the Handbook in a current status. The manufacturer provides the registered owner(s) of the airplane with revisions.

DESCRIPTIVE DATA

ENGINE

Number of Engines: 1
Engine Manufacturer: Teledyne Continental
Engine Model Number: IO-550-N
Engine Type: Normally aspirated, direct drive, air-cooled, horizontally opposed, fuel-injected, six-cylinder engine with 550 $in.^3$ (9013 cm^3) displacement
Takeoff Power: 310 BHP at 2700 RPM
Maximum Continuous Power: 310 BHP at 2700 RPM
Maximum Normal Operating Power: Same as maximum continuous power.
Maximum Climb Power: Same as maximum continuous power.
Maximum Cruise Power: Same as maximum continuous power.

PROPELLER

Propeller Manufacturer: Hartzell
Propeller Hub and Blade Model Number: PHC-J3YF-IRF and F7691D-1
Number of Blades: 3
Propeller Diameter: 76 in. (193 cm) minimum, 77 in. (196 cm) maximum
Propeller Type: Constant speed and hydraulically actuated, with a low pitch setting of $14.1^o \pm 0.2^o$ and a high pitch setting of $34.7^o \pm 1.0^o$ (30 inch station)

FUEL

The following fuel grades, including the respective colors, are approved for this airplane.

100LL Grade Aviation Fuel (Blue)
100 Grade Aviation Fuel (Green)

Total Fuel Capacity - 106 Gallons (401 L)

Total Capacity Each tank: 53 Gallons (201 L)
Total Usable Fuel: 49 Gallons (186 L)/tank, 98 Gallons (371 L) Total

NOTE

Under certain atmospheric conditions, ice can form along various segments of the fuel system. Under these conditions, isopropyl alcohol, ethylene glycol monomethyl ether, or diethylene glycol monomethyl ether may be added to the fuel supply. Additive concentrations shall not exceed 3% for isopropyl alcohol or 0.15% for ethylene glycol monomethyl ether and diethylene glycol monomethyl ether (military specification MIL-I-27686E). See (Figure 8-1) in Section 8 for a chart of fuel additive mixing ratios.

OIL

Specification or Oil Grade (the first 25 engine hours) - Aviation Grade Straight Mineral Oil (MIL-L-6082) shall be used during the first 25 hours of flight operations.

Specification or Oil Grade (after 25 engine hours) - Teledyne Continental Motors Specification MHS-24D and MHS-25 (latest revisions). An ashless dispersant oil shall be used after 25 hours.

Viscosity Recommended for Various Average Air Temperature Ranges
Below 40°F (4°C) — SAE 30, 10W30, 15W50, or 20W50
Above 40°F (4°C) — SAE50, 15W50, 20W/50, or 20W60

Total Oil Capacity
Sump: 8 Quarts (7.6 L)
Total: 10 Quarts* (9.5 L)
Drain and Refill Quantity: 8 Quarts (7.6 L)
Oil Quantity Operating Range: 6 to 8 Quarts (5.7 to 7.6 L)

NOTE*

The first time the airplane is filled with oil, additional oil is required for the filter, oil cooler, and propeller dome. At subsequent oil changes, this additional oil is not drainable from the system, and the added oil is mixed with a few quarts of older oil in the oil system.

MAXIMUM CERTIFICATED WEIGHTS

Ramp Weight:	3400 lbs. (1542 kg)
Takeoff Weight:	3400 lbs. (1542 kg)
Landing Weight:	3230 lbs. (1465 kg)
Baggage Weight:	120 lbs. (54.4 kg)

TYPICAL AIRPLANE WEIGHTS

The empty weight of a typical airplane offered with four-place seating, standard interior, avionics, accessories, and equipment has a standard empty weight of about 2300 lbs. (1043 kg).

Maximum Useful Load: 1100 lbs.* (498.9 kg)
*(The useful load varies for each airplane. Please see Section 6 for specific details.)

CABIN AND ENTRY DIMENSIONS

Maximum Cabin Width: 50 inches (127 cm)
Maximum Cabin Length (Firewall to aft limit of baggage compartment):
139.6 inches (354.6 cm)
Maximum Cabin Height: 49 inches (124.5 cm)
Minimum Entry Width: 33 inches (83.8 cm)
Minimum Entry Height: 33 inches (83.8 cm)
Maximum Entry Clearance: 46 inches (116.8 cm)

SPACE AND ENTRY DIMENSIONS OF BAGGAGE COMPARTMENT

Maximum Baggage Compartment Width: 38.5 inches (97.8 cm)
Maximum Baggage Compartment Length: 52 inches (132 cm) (Including Shelf)
Maximum Baggage Compartment Height: 34.5 inches (87.6 cm)
Maximum Baggage Entry Width: 28 inches (71.1 cm) (Diagonal Measurement)

SPECIFIC LOADINGS

Wing Loading: 24.08 lbs./sq. ft.
Power Loading: 10.97 lbs./hp.

ABBREVIATIONS, TERMINOLOGY, AND SYMBOLS

AIRSPEED TERMINOLOGY

CAS	*Calibrated Airspeed* means the indicated speed of an aircraft, corrected for position and instrument error. Calibrated airspeed is equal to true airspeed in standard atmosphere at sea level.
KCAS	Calibrated Airspeed expressed in knots.
GS	*Ground Speed* is the speed of an airplane relative to the ground.
IAS	*Indicated Airspeed* is the speed of an aircraft as shown in the airspeed indicator when corrected for instrument error. IAS values published in this Handbook assume zero instrument error.
KIAS	Indicated Airspeed expressed in knots.
TAS	*True Airspeed* is the airspeed of an airplane relative to undisturbed air, which is the CAS, corrected for altitude, temperature and compressibility.
V_H	This term refers to the maximum speed in level flight with maximum continuous power.
V_O	*The maximum operating maneuvering speed* of the airplane. Do not apply full or abrupt control movements above this speed. If a maneuver is entered gradually at V_O with maximum weight and full forward CG, the airplane will stall at limit load. However, limit load can be exceeded at V_O if abrupt control movements are used or the CG is farther aft.
V_{FE}	*Maximum Flap Extended Speed* is the highest speed permissible with wing flaps in a prescribed extended position.
V_{NE}	*Never Exceed Speed* is the speed limit that may not be exceeded at any time.
V_{NO}	*Maximum Structural Cruising Speed* is the speed that must not be exceeded except in smooth air and then only with caution.
V_S	*Stalling Speed* or the minimum steady flight speed at which the airplane is controllable.

V_{SO}	*Stalling Speed* or the minimum steady flight speed at which the airplane is controllable in the landing configuration.
V_X	*Best Angle-of-Climb Speed* is the airspeed that delivers the greatest gain of altitude in the shortest possible horizontal distance.
V_Y	*Best Rate-of-Climb Speed* is the airspeed that delivers the greatest gain in altitude in the shortest possible time.

METEOROLOGICAL TERMINOLOGY

ISA	*International Standard Atmosphere* in which: 1. The air is a dry perfect gas; 2. The temperature at sea level (SL) is 15° C (59° F); 3. The pressure at SL is 29.92 inches of Hg. (1013.2 mb); 4. The temperature gradient from SL to an altitude where the temperature is -56.5°C (-69.7°F) is -0.00198°C (-.003564°F) per foot, and zero above that altitude.
Standard Temperature	*Standard Temperature* is 15°C (59ºF) at sea level pressure altitude and decreases 2°C (32°F) for each 1000 feet of altitude.
OAT	*Outside Air Temperature* is the free air static temperature obtained either from in-flight temperature indications or ground meteorological sources, adjusted for instrument error and compressibility effects.
Indicated Pressure Altitude	The number actually read from an altimeter when the barometric subscale has been set to 29.92 inches of Hg (1013.2 mb).
Pressure Altitude (PA)	Altitude measured from standard sea level pressure (29.92 inches of Hg) by a pressure or barometric altimeter. It is the indicated pressure altitude corrected for position and instrument error. In this Handbook, altimeter instrument errors are assumed to be zero.
Station Pressure	Actual atmospheric pressure at field elevation.
Wind	The wind velocities recorded as variables on the charts of this handbook are to be understood as the headwind or tailwind components of the reported winds.

ENGINE POWER & CONTROLS TERMINOLOGY

BHP	*Brake Horsepower* is the power developed by the engine.
EGT Gauge	The *Exhaust Gas Temperature* indicator is the instrument used to identify the lean fuel flow mixtures for various power settings.

MP	*Manifold Pressure* is the pressure measured in the intake system of the engine and is depicted as inches of mercury.
MCP	*Maximum Continuous Power* is the maximum power for abnormal or emergency operations.
Maximum Cruise Power	The maximum power recommended for cruise.
MNOP	*Maximum Normal Operating Power* is the maximum power for all normal operations (except takeoff). This power, in most situations, is the same as Maximum Continuous Power.
Mixture Control	The *Mixture Control* provides a mechanical linkage with the fuel control unit of fuel injection engines, to control the size of the fuel feed aperture, and thus, the air/fuel mixture. It is also a primary means to shut down the engine.
Propeller Control	The lever used to select a propeller speed.
Propeller Governor	The device that regulates the RPM of the engine and propeller by increasing or decreasing the propeller pitch, through a pitch change mechanism in the propeller hub.
RPM	*Revolutions Per Minute* is a measure of engine and/or propeller speed.
Stall Strip	A small triangular strip installed along the leading edge of an airplane wing near the root. The stall strips force the roots of the wing to stall before the tips. The strips allow complete control throughout the stall.
Tachometer	An instrument that indicates propeller rotation and is expressed as revolutions per minute (RPM).
Throttle	The lever used to control engine power, from the lowest through the highest power, by controlling propeller pitch, fuel flow, engine speed, or any combination of these.
Wing Cuff	Specially shaped composite construction on the outboard leading edge of the wing. The cuff increases the camber of the airfoil and improves the slow-flight and stall characteristics of the wing.

AIRPLANE PERFORMANCE & FLIGHT PLANNING TERMINOLOGY

Demonstrated Crosswind Velocity	*Demonstrated Crosswind Velocity* is the velocity of the crosswind component for which adequate control of the airplane can be maintained during takeoff and landing. The value shown is not considered limiting.

G	A unit of acceleration equal to the acceleration of gravity at the surface of the earth. The term is frequently used to quantify additional forces exerted on the airplane and is expressed as multiples of the basic gravitational force, e.g., a 1.7-g force.
GPH	*Gallons Per Hour* is the quantity of fuel consumed in an hour expressed in gallons.
Limit Load	The maximum load a structure is designed to carry and the factor of safety is the percentage of limit load the structure can actually carry before its ultimate load is reached. A structure designed to carry a load of 1,000 pounds with a safety factor of 1.5 has an ultimate load of 1,500 pounds. The airplane can be damaged above limit load.
NMPG	*Nautical Miles per Gallon* is the distance (in nautical miles) which can be expected per gallon of fuel consumed at a specific power setting and/or flight configuration.
PPH	*Pounds Per Hour* is the quantity of fuel consumed in an hour expressed in pounds.
Unusable Fuel	*Unusable Fuel* is the amount of fuel expressed in gallons that cannot safely be used in flight. Unusable Fuel is the fuel remaining after a runout test has been completed in accordance with governmental regulations.
Ultimate Load	The amount of load that can be applied to an aircraft structure before it fails. The airplane can be damaged between limit and ultimate load, and it can fail catastrophically above ultimate load.
Usable Fuel	*Usable Fuel* is the quantity available that can safely be used for flight planning purposes.

WEIGHT AND BALANCE

Arm	The *Arm* is the horizontal distance from the reference datum to the center of gravity (C.G.) of an item.
Basic Empty Weight	The *Basic Empty Weight* is the Standard Empty Weight plus optional equipment.
CG	The *Center of Gravity* is the point at which the airplane will balance if suspended. Its distance from the datum is found by dividing the total moment by the total weight of the airplane.
CG Arm	The arm obtained by adding the individual moments of the airplane and dividing the sum by the total weight.

CG Limits	The extreme center of gravity locations within which the airplane must be operated at a given weight.
Maximum Empty Weight	This is the maximum allowable weight of the airplane when empty, before fuel, passengers, and baggage are added. Subtracting the minimum useful load from the maximum gross weight produces the maximum empty weight. The amount of additional equipment that can be added to the airplane is determined by subtracting the standard empty weight from the maximum empty weight. See page 6-16 for an example.
Maximum Gross Weight	The maximum loaded weight of an aircraft. Gross weight includes the total weight of the aircraft, the weight of the fuel and oil, and the weight of all the load it is carrying.
Maximum Landing Weight	The maximum weight approved for landing touchdown.
Maximum Ramp Weight	The maximum weight approved for ground maneuver. (It includes the weight of the fuel used for startup, taxi, and runup.)
Maximum Takeoff Weight	The maximum weight approved for the start of the takeoff run.
Maximum Zero-Fuel Weight	The maximum weight authorized for an aircraft that does not include the weight of the fuel. This weight includes the basic empty weight plus the weight of the passengers and baggage. The maximum zero-fuel weight can change depending on the center of gravity location. See (Figure 2-4) for an example.
Minimum Flight Weight	This is the minimum weight permitted for flight operations and includes the basic empty weight plus fuel, pilot, passengers, and baggage. The minimum flight weight can change depending on the center of gravity location. See (Figure 2-4) for an example.
Minimum Useful Load	For utility category airplanes, certified for night or IFR operations, a weight of 190 pounds for each installed seat plus the fuel weight for 45 minutes at maximum continuous power.
Moment	The moment of a lever is the distance, in inches, between the point at which a force is applied and the fulcrum, or the point about which a lever rotates, multiplied by the force, in pounds. Moment is expressed in inch-pounds.
Reference Datum	This is an imaginary vertical plane from which all horizontal distances are measured for balance purposes.
Standard Empty Weight	This is the weight of a standard airplane including unusable

	fuel, full operating fluids, and full oil.
Station	The *Station* is a location along the airplane's fuselage usually given in terms of distance from the reference datum, i.e., Station 40 would be 40 inches from the reference datum.
Useful Load	The *Useful Load* is the difference between Takeoff Weight or Ramp Weight, if applicable, and Basic Empty Weight.

MISCELLANEOUS

Flight Time - Airplanes	Pilot time that commences when an aircraft moves under its own power for the purpose of flight and ends when the aircraft comes to rest after landing.
Time in Service	Time in service, with respect to maintenance time records, means the time from the moment an aircraft leaves the surface of the earth until it touches it at the next point of landing.

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REVISIONS & CONVENTIONS USED IN THIS MANUAL

REVISIONS

The data contained in this manual are updated through revisions provided by the manufacturer. Normal revisions are issued every six to nine months depending on the volume of changes. Temporary revisions are issued as needed for urgent matters concerning the airplane. This type of revision is printed on red paper and contains the temporary revision number and date of the revision. Temporary revisions are normally superseded at the next normal revision cycle since they are incorporated into the manual as a normal revision. Revisions are noted in the manual as follows.

1. The date of the initial issue of the *Pilot's Operating Handbook* (POH) is listed on the top line of the footer, at the bottom of the page, near the inside margin.
2. The revision level and date of the latest revision is shown under the initial issuance date.
3. The revised text is cited on the Narrative Discussion of Revisions (NDR) pages, which is included with each revision. The NDR identifies the date of the revision, the revision level, the affected pages, and a discussion of the changes. The NDR pages follow the List of Effective Pages and are numbered sequentially with roman numerals. For example, if the final page number in the List of Effective Pages is x, then the first NDR page will be number xi.

It is the responsibility of the owner or operator of the airplane to keep this manual current. Use the following procedures to verify that all applicable revisions are incorporated in the POH.

1. Determine the latest normal revision level by referring to the Log of Normal Revisions beginning on page iii of the manual. The information in this part lists the revision level and date, the affected pages, and a brief description of the changes. If there is doubt about the applicable revision level, this can be determined by contacting the manufacturer as shown in Section 8 of this handbook.
2. Next, refer to the Log of Temporary Revisions, which begins on page v, and determine the latest revision level. Again, if there is doubt concerning the latest temporary revision number, contact the manufacturer as shown in Section 8.
3. If the logs of normal and temporary revisions contain the latest revision levels, perform an audit of the pages in the handbook using the List of Effective Pages (LOEP), which begins on page vii. First, verify that the revision levels shown at the bottom of the page for both revision logs agree with the numbers shown at the bottom of the LOEP. For example, if the LOEP shows a revision level of B for page 7-21, turn to that page and ensure that the information in the footer agrees with the revision level, e.g., B/04-15-00. Perform this procedure for each revised page in the LOEP.
   a. On the List of Effective Pages, the revision levels and dates of revision are contained in the footer at the bottom of the page for both normal and temporary revisions. Temporary revisions are prefixed, with the letter *T*.
   b. For example, the notation B/04-15-2000 // T1/06-12-2000 indicates that the second normal revision was issued on April 15, 2000 and the first temporary revision was issued on June 12, 2000. These dates and revision levels should be the same in the footer of the respective revision logs.

SUPPLEMENTS

Equipment, which is not covered in Sections 1 through 8 in the Pilot's Operating Handbook, is included in Section 9, as applicable.

USE OF THE TERMS WARNING, CAUTION, AND NOTE

The following conventions will be used for the terms, *Warning*, *Caution*, and *Note*.

WARNING

The use of a Warning symbol means that information which follows is of critical importance and concerns procedures and techniques which could cause or result in personal injury or death if not carefully followed.

CAUTION

The use of a Caution symbol means that information which follows is of significant importance and concerns procedures and techniques which could cause or result in damage to the airplane and/or its equipment if not carefully followed.

NOTE

The use of the term "NOTE" means the information that follows is essential to emphasize.

MEANING OF *SHALL*, *WILL*, *SHOULD*, AND *MAY*

The words *shall* and *will* are used to denote a mandatory requirement. The word *should* denotes something that is recommended but not mandatory. The word *may* is permissive in nature and suggests something that is optional.

MEANING OF *LAND AS SOON AS POSSIBLE* OR *PRACTICABLE*

The use of these two terms relates to the urgency of the situation. When it is suggested to **land as soon as possible**, this means to land at the nearest suitable airfield after considering weather conditions, ambient lighting, approach facilities, and landing requirements. When it is suggested to **land as soon as practicable**, this means that the flight may be continued to an airport with superior facilities, including maintenance support, and weather conditions.

CONVERSION CHARTS

On the following pages are a series of charts and graphs for conversion to and from U.S. weights and measures to metric and imperial equivalents. The charts and graphs are included to help pilots who live in countries other than the United States or pilots from the United States who are traveling to or within other countries.

KILOGRAMS AND POUNDS

CONVERTING KILOGRAMS TO POUNDS										
Kilograms	0	1	2	3	4	5	6	7	8	9
0		2.205	4.409	6.614	8.818	11.023	13.228	15.432	17.637	19.842
10	22.046	24.251	26.455	28.660	30.865	33.069	35.274	37.479	39.683	41.888
20	44.092	46.297	48.502	50.706	52.911	55.116	57.320	59.525	61.729	63.934
30	66.139	68.343	70.548	72.753	74.957	77.162	79.366	81.571	83.776	85.980
40	88.185	90.390	92.594	94.799	97.003	99.208	101.413	103.617	105.822	108.026
50	110.231	112.436	114.640	116.845	119.050	121.254	123.459	125.663	127.868	130.073
60	132.277	134.482	136.687	138.891	141.096	143.300	145.505	147.710	149.914	152.119
70	154.324	156.528	158.733	160.937	163.142	165.347	167.551	169.756	171.961	174.165
80	176.370	178.574	180.779	182.984	185.188	187.393	189.597	191.802	194.007	196.211
90	198.416	200.621	202.825	205.030	207.234	209.439	211.644	213.848	216.053	218.258
100	220.462	222.667	224.871	227.076	229.281	231.485	233.690	235.895	238.099	240.304

Example: Convert 76 kilograms to pounds. Locate the 70 row in the first column and then move right, horizontally to Column No. 6 and read the solution, 167.551 pounds.

(Figure 1-2)

CONVERTING POUNDS TO KILOGRAMS										
Pounds	0	1	2	3	4	5	6	7	8	9
0		0.454	0.907	1.361	1.814	2.268	2.722	3.175	3.629	4.082
10	4.536	4.990	5.443	5.897	6.350	6.804	7.257	7.711	8.165	8.618
20	9.072	9.525	9.979	10.433	10.886	11.340	11.793	12.247	12.701	13.154
30	13.608	14.061	14.515	14.969	15.422	15.876	16.329	16.783	17.236	17.690
40	18.144	18.597	19.051	19.504	19.958	20.412	20.865	21.319	21.772	22.226
50	22.680	23.133	23.587	24.040	24.494	24.948	25.401	25.855	26.308	26.762
60	27.216	27.669	28.123	28.576	29.030	29.483	29.937	30.391	30.844	31.298
70	31.751	32.205	32.659	33.112	33.566	34.019	34.473	34.927	35.380	35.834
80	36.287	36.741	37.195	37.648	38.102	38.555	39.009	39.463	39.916	40.370
90	40.823	41.277	41.730	42.184	42.638	43.091	43.545	43.998	44.452	44.906
100	45.359	45.813	46.266	46.720	47.174	47.627	48.081	48.534	48.988	49.442

Example: Convert 40 pounds to kilograms. Locate the 40 row in the first column and then move right one column to Column No. 0 and read the solution, 18.144 kilograms.

(Figure 1-3)

FEET AND METERS

CONVERTING METERS TO FEET										
Meters	0	1	2	3	4	5	6	7	8	9
0		3.281	6.562	9.843	13.123	16.404	19.685	22.966	26.247	29.528
10	32.808	36.089	39.370	42.651	45.932	49.213	52.493	55.774	59.055	62.336
20	65.617	68.898	72.178	75.459	78.740	82.021	85.302	88.583	91.864	95.144
30	98.425	101.706	104.987	108.268	111.549	114.829	118.110	121.391	124.672	127.953
40	131.234	134.514	137.795	141.076	144.357	147.638	150.919	154.199	157.480	160.761
50	164.042	167.323	170.604	173.885	177.165	180.446	183.727	187.008	190.289	193.570
60	196.850	200.131	203.412	206.693	209.974	213.255	216.535	219.816	223.097	226.378
70	229.659	232.940	236.220	239.501	242.782	246.063	249.344	252.625	255.906	259.186
80	262.467	265.748	269.029	272.310	275.591	278.871	282.152	285.433	288.714	291.995
90	295.276	298.556	301.837	305.118	308.399	311.680	314.961	318.241	321.522	324.803
100	328.084	331.365	334.646	337.927	341.207	344.488	347.769	351.050	354.331	357.612
Example: Refer to (Figure 1-2) and (Figure 1-3) for examples of how to use these types of tables.										

(Figure 1-4)

CONVERTING FEET TO METERS										
Feet	0	1	2	3	4	5	6	7	8	9
0		0.305	0.610	0.914	1.219	1.524	1.829	2.134	2.438	2.743
10	3.048	3.353	3.658	3.962	4.267	4.572	4.877	5.182	5.486	5.791
20	6.096	6.401	6.706	7.010	7.315	7.620	7.925	8.230	8.534	8.839
30	9.144	9.449	9.754	10.058	10.363	10.668	10.973	11.278	11.582	11.887
40	12.192	12.497	12.802	13.106	13.411	13.716	14.021	14.326	14.630	14.935
50	15.240	15.545	15.850	16.154	16.459	16.764	17.069	17.374	17.678	17.983
60	18.288	18.593	18.898	19.202	19.507	19.812	20.117	20.422	20.726	21.031
70	21.336	21.641	21.946	22.250	22.555	22.860	23.165	23.470	23.774	24.079
80	24.384	24.689	24.994	25.298	25.603	25.908	26.213	26.518	26.822	27.127
90	27.432	27.737	28.042	28.346	28.651	28.956	29.261	29.566	29.870	30.175
100	30.480	30.785	31.090	31.394	31.699	32.004	32.309	32.614	32.918	33.223
Example: Refer to (Figure 1-2) and (Figure 1-3) for examples of how to use these types of tables.										

(Figure 1-5)

INCHES AND CENTIMETERS

CONVERTING CENTIMETERS TO INCHES										
Centimeters	0	1	2	3	4	5	6	7	8	9
0		0.394	0.787	1.181	1.575	1.969	2.362	2.756	3.150	3.543
10	3.937	4.331	4.724	5.118	5.512	5.906	6.299	6.693	7.087	7.480
20	7.874	8.268	8.661	9.055	9.449	9.843	10.236	10.630	11.024	11.417
30	11.811	12.205	12.598	12.992	13.386	13.780	14.173	14.567	14.961	15.354
40	15.748	16.142	16.535	16.929	17.323	17.717	18.110	18.504	18.898	19.291
50	19.685	20.079	20.472	20.866	21.260	21.654	22.047	22.441	22.835	23.228
60	23.622	24.016	24.409	24.803	25.197	25.591	25.984	26.378	26.772	27.165
70	27.559	27.953	28.346	28.740	29.134	29.528	29.921	30.315	30.709	31.102
80	31.496	31.890	32.283	32.677	33.071	33.465	33.858	34.252	34.646	35.039
90	35.433	35.827	36.220	36.614	37.008	37.402	37.795	38.189	38.583	38.976
100	39.370	39.764	40.157	40.551	40.945	41.339	41.732	42.126	42.520	42.913
Example: Refer to (Figure 1-2) and (Figure 1-3) for examples of how to use these types of tables.										

(Figure 1-6)

CONVERTING INCHES TO CENTIMETERS										
Inches	0	1	2	3	4	5	6	7	8	9
0		2.54	5.08	7.62	10.16	12.70	15.24	17.78	20.32	22.86
10	25.40	27.94	30.48	33.02	35.56	38.10	40.64	43.18	45.72	48.26
20	50.80	53.34	55.88	58.42	60.96	63.50	66.04	68.58	71.12	73.66
30	76.20	78.74	81.28	83.82	86.36	88.90	91.44	93.98	96.52	99.06
40	101.60	104.14	106.68	109.22	111.76	114.30	116.84	119.38	121.92	124.46
50	127.00	129.54	132.08	134.62	137.16	139.70	142.24	144.78	147.32	149.86
60	152.40	154.94	157.48	160.02	162.56	165.10	167.64	170.18	172.72	175.26
70	177.80	180.34	182.88	185.42	187.96	190.50	193.04	195.58	198.12	200.66
80	203.20	205.74	208.28	210.82	213.36	215.90	218.44	220.98	223.52	226.06
90	228.60	231.14	233.68	236.22	238.76	241.30	243.84	246.38	248.92	251.46
100	254.00	256.54	259.08	261.62	264.16	266.70	269.24	271.78	274.32	276.86
Example: Refer to (Figure 1-2) and (Figure 1-3) for examples of how to use these types of tables.										

(Figure 1-7)

NAUTICAL MILES, STATUTE MILES, AND KILOMETERS

Nautical Miles	Statute Miles	Kilo-meters	Nautical Miles	Statute Miles	Kilo-meters	Nautical Miles	Statute Miles	Kilo-meters
5	6	9	175	202	324	345	397	639
10	12	19	180	207	333	350	403	648
15	17	28	185	213	343	355	409	657
20	23	37	190	219	352	360	415	667
25	29	46	195	225	361	365	420	676
30	35	56	200	230	370	370	426	685
35	40	65	205	236	380	375	432	695
40	46	74	210	242	389	380	438	704
45	52	83	215	248	398	385	443	713
50	58	93	220	253	407	390	449	722
55	63	102	225	259	417	395	455	732
60	69	111	230	265	426	400	461	741
65	75	120	235	271	435	405	466	750
70	81	130	240	276	444	410	472	759
75	86	139	245	282	454	415	478	769
80	92	148	250	288	463	420	484	778
85	98	157	255	294	472	425	489	787
90	104	167	260	299	482	430	495	796
95	109	176	265	305	491	435	501	806
100	115	185	270	311	500	440	507	815
105	121	194	275	317	509	445	512	824
110	127	204	280	322	519	450	518	833
115	132	213	285	328	528	455	524	843
120	138	222	290	334	537	460	530	852
125	144	232	295	340	546	465	535	861
130	150	241	300	345	556	470	541	870
135	155	250	305	351	565	475	547	880
140	161	259	310	357	574	480	553	889
145	167	269	315	363	583	485	559	898
150	173	278	320	369	593	490	564	907
155	178	287	325	374	602	495	570	917
160	184	296	330	380	611	500	576	926
165	190	306	335	386	620	505	582	935
170	196	315	340	392	630	510	587	945

(Figure 1-8)

LITERS, IMPERIAL GALLONS, AND U.S. GALLONS

CONVERTING LITERS TO IMPERIAL GALLONS										
Liters	0	1	2	3	4	5	6	7	8	9
0		0.22	0.44	0.66	0.88	1.10	1.32	1.54	1.76	1.98
10	2.20	2.42	2.64	2.86	3.08	3.30	3.52	3.74	3.96	4.18
20	4.40	4.62	4.84	5.06	5.28	5.50	5.72	5.94	6.16	6.38
30	6.60	6.82	7.04	7.26	7.48	7.70	7.92	8.14	8.36	8.58
40	8.80	9.02	9.24	9.46	9.68	9.90	10.12	10.34	10.56	10.78
50	11.00	11.22	11.44	11.66	11.88	12.10	12.32	12.54	12.76	12.98
60	13.20	13.42	13.64	13.86	14.08	14.30	14.52	14.74	14.96	15.18
70	15.40	15.62	15.84	16.06	16.28	16.50	16.72	16.94	17.16	17.38
80	17.60	17.82	18.04	18.26	18.48	18.70	18.92	19.14	19.36	19.58
90	19.80	20.02	20.24	20.46	20.68	20.90	21.12	21.34	21.56	21.78
100	22.00	22.22	22.44	22.66	22.88	23.10	23.32	23.54	23.76	23.98
Example: Refer to (Figure 1-2) and (Figure 1-3) for examples of how to use these types of tables.										

(Figure 1-9)

CONVERTING IMPERIAL GALLONS TO LITERS										
Imperial Gallons	0	1	2	3	4	5	6	7	8	9
0	0.00	4.55	9.09	13.64	18.18	22.73	27.28	31.82	36.37	40.91
10	45.46	50.01	54.55	59.10	63.64	68.19	72.74	77.28	81.83	86.37
20	90.92	95.47	100.01	104.56	109.10	113.65	118.20	122.74	127.29	131.83
30	136.38	140.93	145.47	150.02	154.56	159.11	163.66	168.20	172.75	177.29
40	181.84	186.39	190.93	195.48	200.02	204.57	209.12	213.66	218.21	222.75
50	227.30	231.85	236.39	240.94	245.48	250.03	254.58	259.12	263.67	268.21
60	272.76	277.31	281.85	286.40	290.94	295.49	300.04	304.58	309.13	313.67
70	318.22	322.77	327.31	331.86	336.40	340.95	345.50	350.04	354.59	359.13
80	363.68	368.23	372.77	377.32	381.86	386.41	390.96	395.50	400.05	404.59
90	409.14	413.69	418.23	422.78	427.32	431.87	436.42	440.96	445.51	450.05
100	454.60	459.15	463.69	468.24	472.78	477.33	481.88	486.42	490.97	495.51
Example: Refer to (Figure 1-2) and (Figure 1-3) for examples of how to use these types of tables.										

(Figure 1-10)

CONVERTING LITERS TO U.S. GALLONS										
Liters	0	1	2	3	4	5	6	7	8	9
0	0.00	0.26	0.53	0.79	1.06	1.32	1.59	1.85	2.11	2.38
10	2.64	2.91	3.17	3.43	3.70	3.96	4.23	4.49	4.76	5.02
20	5.28	5.55	5.81	6.08	6.34	6.60	6.87	7.13	7.40	7.66
30	7.93	8.19	8.45	8.72	8.98	9.25	9.51	9.77	10.04	10.30
40	10.57	10.83	11.10	11.36	11.62	11.89	12.15	12.42	12.68	12.94
50	13.21	13.47	13.74	14.00	14.27	14.53	14.79	15.06	15.32	15.59
60	15.85	16.11	16.38	16.64	16.91	17.17	17.44	17.70	17.96	18.23
70	18.49	18.76	19.02	19.28	19.55	19.81	20.08	20.34	20.61	20.87
80	21.13	21.40	21.66	21.93	22.19	22.45	22.72	22.98	23.25	23.51
90	23.78	24.04	24.30	24.57	24.83	25.10	25.36	25.62	25.89	26.15
100	26.42	26.68	26.95	27.21	27.47	27.74	28.00	28.27	28.53	28.79
Example: Refer to (Figure 1-2) and (Figure 1-3) for examples of how to use these types of tables.										

(Figure 1-11)

CONVERTING U.S. GALLONS TO LITERS										
U.S. Gallons	0	1	2	3	4	5	6	7	8	9
0	0.00	3.79	7.57	11.36	15.14	18.93	22.71	26.50	30.28	34.07
10	37.85	41.64	45.42	49.21	52.99	56.78	60.56	64.35	68.13	71.92
20	75.70	79.49	83.27	87.06	90.84	94.63	98.41	102.20	105.98	109.77
30	113.55	117.34	121.12	124.91	128.69	132.48	136.26	140.05	143.83	147.62
40	151.40	155.19	158.97	162.76	166.54	170.33	174.11	177.90	181.68	185.47
50	189.25	193.04	196.82	200.61	204.39	208.18	211.96	215.75	219.53	223.32
60	227.10	230.89	234.67	238.46	242.24	246.03	249.81	253.60	257.38	261.17
70	264.95	268.74	272.52	276.31	280.09	283.88	287.66	291.45	295.23	299.02
80	302.80	306.59	310.37	314.16	317.94	321.73	325.51	329.30	333.08	336.87
90	340.65	344.44	348.22	352.01	355.79	359.58	363.36	367.15	370.93	374.72
100	378.50	382.29	386.07	389.86	393.64	397.43	401.21	405.00	408.78	412.57
Example: Refer to (Figure 1-2) and (Figure 1-3) for examples of how to use these types of tables.										

(Figure 1-12)

CONVERTING IMPERIAL GALLONS TO U.S. GALLONS										
Imperial Gallons	0	1	2	3	4	5	6	7	8	9
0	0.00	1.20	2.40	3.60	4.80	6.01	7.21	8.41	9.61	10.81
10	12.01	13.21	14.41	15.61	16.81	18.02	19.22	20.42	21.62	22.82
20	24.02	25.22	26.42	27.62	28.82	30.03	31.23	32.43	33.63	34.83
30	36.03	37.23	38.43	39.63	40.83	42.04	43.24	44.44	45.64	46.84
40	48.04	49.24	50.44	51.64	52.84	54.05	55.25	56.45	57.65	58.85
50	60.05	61.25	62.45	63.65	64.85	66.06	67.26	68.46	69.66	70.86
60	72.06	73.26	74.46	75.66	76.86	78.07	79.27	80.47	81.67	82.87
70	84.07	85.27	86.47	87.67	88.87	90.08	91.28	92.48	93.68	94.88
80	96.08	97.28	98.48	99.68	100.88	102.09	103.29	104.49	105.69	106.89
90	108.09	109.29	110.49	111.69	112.89	114.10	115.30	116.50	117.70	118.90
100	120.10	121.30	122.50	123.70	124.90	126.11	127.31	128.51	129.71	130.91
Example: Refer to (Figure 1-2) and (Figure 1-3) for examples of how to use these types of tables.										

(Figure 1-13)

CONVERTING U.S. GALLONS TO IMPERIAL GALLONS										
U.S. Gallons	0	1	2	3	4	5	6	7	8	9
0	0.00	0.83	1.67	2.50	3.33	4.16	5.00	5.83	6.66	7.49
10	8.33	9.16	9.99	10.82	11.66	12.49	13.32	14.16	14.99	15.82
20	16.65	17.49	18.32	19.15	19.98	20.82	21.65	22.48	23.32	24.15
30	24.98	25.81	26.65	27.48	28.31	29.14	29.98	30.81	31.64	32.47
40	33.31	34.14	34.97	35.81	36.64	37.47	38.30	39.14	39.97	40.80
50	41.63	42.47	43.30	44.13	44.96	45.80	46.63	47.46	48.30	49.13
60	49.96	50.79	51.63	52.46	53.29	54.12	54.96	55.79	56.62	57.45
70	58.29	59.12	59.95	60.79	61.62	62.45	63.28	64.12	64.95	65.78
80	66.61	67.45	68.28	69.11	69.95	70.78	71.61	72.44	73.28	74.11
90	74.94	75.77	76.61	77.44	78.27	79.10	79.94	80.77	81.60	82.44
100	83.27	84.10	84.93	85.77	86.60	87.43	88.26	89.10	89.93	90.76
Example: Refer to (Figure 1-2) and (Figure 1-3) for examples of how to use these types of tables.										

(Figure 1-14)

TEMPERATURE RELATIONSHIPS (FAHRENHEIT AND CELSIUS)

Fahrenheit	Celsius	Fahrenheit	Celsius	Fahrenheit	Celsius
-40F	-40C	145F	63C	330F	166C
-35F	-37C	150F	66C	335F	168C
-30F	-34C	155F	68C	340F	171C
-25F	-32C	160F	71C	345F	174C
-20F	-29C	165F	74C	350F	177C
-15F	-26C	170F	77C	355F	179C
-10F	-23C	175F	79C	360F	182C
-5F	-21C	180F	82C	365F	185C
0F	-18C	185F	85C	370F	188C
5F	-15C	190F	88C	375F	191C
10F	-12C	195F	91C	380F	193C
15F	-9C	200F	93C	385F	196C
20F	-7C	205F	96C	390F	199C
25F	-4C	210F	99C	395F	202C
30F	-1C	215F	102C	400F	204C
35F	2C	220F	104C	405F	207C
40F	4C	225F	107C	410F	210C
45F	7C	230F	110C	415F	213C
50F	10C	235F	113C	420F	216C
55F	13C	240F	116C	425F	218C
60F	16C	245F	118C	430F	221C
65F	18C	250F	121C	435F	224C
70F	21C	255F	124C	440F	227C
75F	24C	260F	127C	445F	229C
80F	27C	265F	129C	450F	232C
85F	29C	270F	132C	455F	235C
90F	32C	275F	135C	460F	238C
95F	35C	280F	138C	465F	241C
100F	38C	285F	141C	470F	243C
105F	41C	290F	143C	475F	246C
110F	43C	295F	146C	480F	249C
115F	46C	300F	149C	485F	252C
120F	49C	305F	152C	490F	254C
125F	52C	310F	154C	495F	257C
130F	54C	315F	157C	500F	260C
135F	57C	320F	160C	505F	263C
140F	60C	325F	163C	510F	266C

(Figure 1-15)

FUEL WEIGHTS AND CONVERSION RELATIONSHIPS

The table below summarizes the weights and conversion relationships for liters, U.S. Gallons, and Imperial Gallons. The chart values are only to two decimal places. The table is intended to provide approximate values for converting from one particular quantity of measurement to another.

Quantity	Weight		Converting To U.S. Gallons	Converting To Imperial Gallons	Converting To Liters
	Kg.	Lbs.			
Liters	0.72	1.58	26% of the liter quantity	22% of the liter quantity	
Imperial Gallons	3.72	7.2	1.2 times the number of Imperial Gallons		4.55 times the number of Imperial Gallons
U.S. Gallons	2.72	6.0		83% of the U.S. Gallon quantity	3.78 times the number of U.S. Gallons

(Figure 1-16)

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Section 2
Limitations

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Section 2
Limitations

INTRODUCTION

Section 2 contains the operating limitations of this airplane. The Federal Aviation Agency approves the limitations included in this Section. These include operating limitations, instrument markings, and basic placards necessary for the safe operation of the airplane, the airplane's engine, the airplane's standard systems, and the airplane's standard equipment.

NOTE

This section covers limitations associated with the standard systems and equipment in the airplane. Refer to Section 9 for amended operating procedures, limitations, and related performance data.

LIMITATIONS

AIRSPEED LIMITATIONS

The airspeed limitations below are based on the maximum gross takeoff weight of 3400 lbs (1542 kg). The maximum operating maneuvering speeds (V_O) and applicable gross weight limitations are shown in (Figure 2-1).

	SPEED	KCAS	KIAS	REMARKS
V_O	Max. Operating Maneuvering Speed 2500 Pounds Gross Weight 3400 Pounds Gross Weight	 128 149	 127 148	Do not apply full or abrupt control movements above this speed.
V_{FE}	Maximum Flap Extended Speed (Down or 40^O Flap Setting)	120	119	Do not exceed this speed with full flaps. Takeoff flaps can be extended at 130 KCAS (129 KIAS).
V_{NO}	Max. Structural Cruising Speed *Decrease 4 knots for each 1000-ft above 12,000 feet (Press. Alt.)	180*	179*	Do not exceed this speed except in smooth air and then only with caution.
V_{NE}	Never Exceed Speed *Decrease 5 knots for each 1000-ft above 12,000 feet (Press. Alt.)	235*	235*	Do not exceed this speed in any operation.

(Figure 2-1)

AIRSPEED INDICATOR MARKINGS

The outer circumference of the airspeed indicator has four colored arcs. The meaning and range of each arc is tabulated in (Figure 2-2).

MARKING	KIAS VALUE OR RANGE	SIGNIFICANCE
White Arc	57 - 119	Full Flap Operating Range - Lower limit is maximum weight stalling speed in the landing configuration. Upper limit is maximum speed permissible with flaps extended.
Green Arc	71 - 179	Normal Operating Range - Lower limit is maximum weight stalling speed with flaps retracted. Upper limit is maximum structural cruising speed.
Yellow Arc	179 – 235	Operations must be conducted with caution and only in smooth air.
Red Line	235	Maximum speed for all operations

(Figure 2-2)

POWERPLANT LIMITATIONS

Number of Engines: One (1)
Engine Manufacturer: Teledyne Continental
Engine Model Number: IO-550-N
Recommended Time Between Overhaul: 2000 Hours (Time in Service)
Maximum Power: 310 BHP at 2700 RPM
Maximum Manifold Pressure: Full power at sea level
Maximum Recommended Cruise: 248 BHP (80%)
Maximum Cylinder Head Temperature: 460°F (238°C)

POWERPLANT FUEL AND OIL DATA

Oil Grades Recommended for Various Average Air Temperature Ranges

Below 40°F (4°C) — SAE 30, 10W30, 15W50, or 20W50
Above 40°F (4°C) — SAE50, 15W50, 20W/50, or 20W60

Oil Temperature

Maximum Allowable: 240ºF (116°C)
Recommended takeoff minimum: 100°F (38°C)
Recommended flight operations: 170°F to 200°F (77°C to 93°C)

Oil Pressures

Normal Operations: 30-60 psi (pounds per square inch)
Idle, minimum: 10 psi
Maximum allowable (cold oil): 100 psi

Approved Fuel Grades

100LL Grade Aviation Fuel (Blue)
100 Grade Aviation Fuel (Green)

Fuel Flow and Fuel Pressure

Normal Operations: 10 to 22 GPH (38 to 83 LPH) (7 to 16 psi)
Idle, minimum: 1 to 2 GPH (3.8 to 7.6 LPH) (4 psi)
Maximum allowable: 28 GPH (106 LPH) (22 psi)

POWERPLANT INSTRUMENT MARKINGS

The following table (Figure 2-3) shows applicable color-coded ranges for the various powerplant instruments within the aircraft.

INSTRUMENT	RED LINE Minimum Limit	GREEN ARC Normal Operating	RED LINE Limit
Tachometer	Minimum for idle 600 RPM*	2000 – 2700 RPM	2700 RPM
Manifold Pressure		18 – 28 Inches Hg. (No Placard)	
Oil Temperature	Minimum for takeoff 100ºF* (38°C)	170ºF – 200ºF (77°C – 93°C)	30ºF to 100ºF (-1°C to 38°C) 240ºF to 250ºF (116°C to 121°C)
Oil Pressure	Minimum for idle 10 psi	30 - 60 psi	100 psi * (Cold Oil)
Fuel Quantity	A red line below "E" or "zero" indicates the remaining four gallons in each tank cannot be used safely in flight.		
Fuel Pressure/Fuel Flow		10 – 22 GPH (38 – 83 LPH) 4 – 14 psi*	28 GPH (106 LPH) (22 psi)
Cylinder Head Temperature		240ºF – 460ºF (116°C – 238°C)	460ºF (238°C)
Vacuum		4.5 – 5.2 Inches Hg.	

* These temperatures or pressures are not marked on the gauge. However, it is important information that the pilot must be aware of.

(Figure 2-3)

PROPELLER DATA AND LIMITATIONS

Number of Propellers: 1
Propeller Manufacture: Hartzell
Propeller Hub and Blade Model Numbers: PHC-J3YF-IRF and F7691D-1

Propeller Diameters

Minimum: 76 in. (193 cm)
Maximum: 77 in. (196 cm)

Propeller Blade Angle at 30 inch Station Pressure

Low: 14.1° (± 0.2º)
High: 34.7° (± 1.0º)

POWER SETTING LIMITATIONS

Do not exceed 20 inches of Hg. of manifold pressure below 2200 RPM. This requirement is not an engine limitation, but rather a harmonic condition inherent in the Columbia 300 (LC40-550FG).

WEIGHT LIMITS	Utility Category
Maximum Ramp Weight:	3400 lbs. (1542 kg)
Maximum Empty Weight:	2568 lbs. (1165 kg)
Maximum Takeoff Weight:	3400 lbs. (1542 kg)
Maximum Landing Weight:	3230 lbs. (1465 kg)
Maximum Baggage Weight:*	120 lbs. (54.4 kg)

*The baggage compartment has two areas, the main area and the hat rack area. The combined weight in these areas cannot exceed 120 pounds (54.4 kg). The main area is centered at station 166.6 with maximum weight allowance of 120 pounds (54.4 kg). The hat rack area, which is centered at station 199.8, has a maximum weight allowance of 20 pounds (9.1 kg). When loading baggage in the main baggage compartment, Zone A (the forward portion of the main baggage area) must always be loaded first. See page 6-13 for diagram of loading stations and baggage zones.

OTHER WEIGHT LIMITATIONS

TYPE OF WEIGHT LIMITATION	FORWARD DATUM POINT AND WEIGHT	AFT DATUM POINT AND WEIGHT	VARIATION
Minimum Flying Weight	103 inches and 2240 lbs.	110 inches and 2500 lbs.	Straight Line
Maximum Zero Fuel Weight	103 inches and 2725 lbs.	110 inches and 3228 lbs.	Straight Line

Reference Datum: The reference datum is located near the tip of the propeller spinner. As distance from the datum increases, there is an increase in weight for each of the two limitation categories. The variation is linear or straight line from the fore to the aft positions.

(Figure 2-4)

CENTER OF GRAVITY LIMITS

(Figure 2-5) specifies the center of gravity limits for utility category operations. The variation along the arm between the forward and aft datum points is linear or straight line. The straight-line variation means that at any given point along the arm, an increase in moments changes directly according to the variations in weight and distance from the datum.

CENTER OF GRAVITY TABLE

CATEGORY	FORWARD DATUM POINT AND WEIGHT	AFT DATUM POINT AND WEIGHT	VARIATION
Utility Category	103 inches 2240 to 2500 lbs.	110 inches 2500 to 3400 lbs.	Straight Line

Reference Datum: The reference datum is located at the tip of the propeller spinner. This location causes all arm distances and moments (the product of arm and weight) to be positive values.

(Figure 2-5)

MANEUVER LIMITS

Utility Category – This airplane is certified in the utility category. Only the acrobatic maneuvers shown in (Figure 2-6) are approved.

APPROVED ACROBATIC MANEUVERS

MANEUVER	ENTRY SPEED
Chandelles	150 KIAS
Lazy Eights	150 KIAS
Steep Turns	150 KIAS
Stalls	Slow Deceleration*
* Ensure that maximum fuel imbalance does not exceed 10 gallons (38 L).	
SPINS PROHIBITED	

(Figure 2-6)

While there are no limitations to the performance of the acrobatic maneuvers listed in (Figure 2-6), it is recommended that the pilot not exceed 60º of bank since this will improve the service life of the gyros. Also, it is important to remember that the airplane accelerates quite rapidly in a nose down attitude, such as when performing a lazy eight.

SPINS

The airplane, as certified by the Federal Aviation Agency, is not approved for spins of any duration. During the flight test phase of the airplane's certification, spins and/or spin recovery techniques were not performed or demonstrated. It is not known if the airplane will recover from a spin.

WARNING

Do not attempt to spin the airplane under any circumstances. The airplane, as certified by the Federal Aviation Agency, is not approved for spins of any duration. During the flight test phase of the airplane's certification, spins were not performed. It is not known if the airplane will recover from a spin.

FLIGHT LOAD FACTOR LIMITS

Utility Category - Maximum flight load factors for all weights are:

Flaps Position	Max. Load Factor
Up (Cruise Position)	+4.4g and -1.76g
Down (Landing Position)	+2.0g and -0.0g

KINDS OF OPERATION LIMITS AND PILOT REQUIREMENTS

The airplane has the necessary equipment available and is certified for daytime and nighttime VFR and IFR operations with only one pilot. The operational minimum equipment and instrumentation for the kinds of operation are detailed in Part 91 of the FAR's. (U.S. operating rules do not apply in Canada.)

ICING CONDITIONS

Flight into known icing is prohibited.

FUEL LIMITATIONS

Total Capacity: 106 US Gallons (401 L)
Total Capacity Each tank: 53 US Gallons (201 L)
Total Usable Fuel: 49 US Gallons (186 L)/in each tank (98 US Gallons (371 L) Total)
Maximum Fuel Imbalance: 10 US gallons (38 L) between left and right fuel tanks

ELECTRONIC DISPLAY LIMITATIONS

The MX20 is Limited to VFR Navigation Only. The information currently displayed on the MX20 is approved only to enhance situational awareness and aid in VFR navigation. It is not certified for use as an IFR instrument. All IFR navigation and IFR operations will be conducted by primary reference to the primary flight instruments, primary navigation systems and displays, and current and approved IFR charts. The MX20 can be operating and can be referenced during IFR conditions to facilitate situational awareness, but it should not be used as an IFR navigation tool. This limitation is not intended to restrict the pilot from using the MX20 as necessary in dealing with an unsafe situation. The pilot should always use the best information available to make timely safety-of-flight decisions.

OTHER LIMITATIONS

Altitude – The maximum flight altitude is 18,000 MSL with an FAA approved oxygen installation and 14,000 MSL without oxygen installed. See FAR Part 91 for applicable oxygen requirements.

Flap Limitations

Approved Takeoff Range: 12°
Approved Landing Range: 12° and 40°

Passenger Seating Capacity – The maximum passenger seating configuration is four persons.

Rudder Limiter - If the rudder limiter is found to be inoperative during the preflight inspection, the problem must be corrected before flying the airplane. If the rudder limiter becomes inoperative or malfunctions during flight, then a landing must be made as soon as possible or practicable depending on the problem. In an emergency situation, with the rudder limiter permanently engaged, the airplane is limited to a maximum right crosswind component of six knots. Please see page 3-18 for a discussion of the applicable emergency procedures. Continuous operation of the rudder limiter must not exceed a 15% duty cycle. For more information on stalls and the stall warning system, please refer to pages 4-24 and 7-47, respectively.

PLACARDS

GENERAL

Federal Aviation Regulations require that a number of different placards be prominently displayed on the interior and exterior of the airplane. The placards contain information about the airplane and its operation that is of significant importance. The placard is placed in a location proximate to the item it describes. For example, the fuel capacity placard is near the tank filler caps. The placards and their locations are shown on the following pages as they appear on the interior and exterior of the airplane.

INTERIOR PLACARDS

On Center Console Below Radios

FIRE EXTINGUISHER LOCATED UNDER CO-PILOT'S SEAT

The markings and placards installed in this airplane contain operating limitations which must be complied with when operating this airplane in the Utility category. Other operating limitations which must be complied with when operating this airplane in this category are contained in the Airplane Flight Manual.

Utility Category – No acrobatic maneuvers approved, except those listed in the Pilot's Operating Handbook.

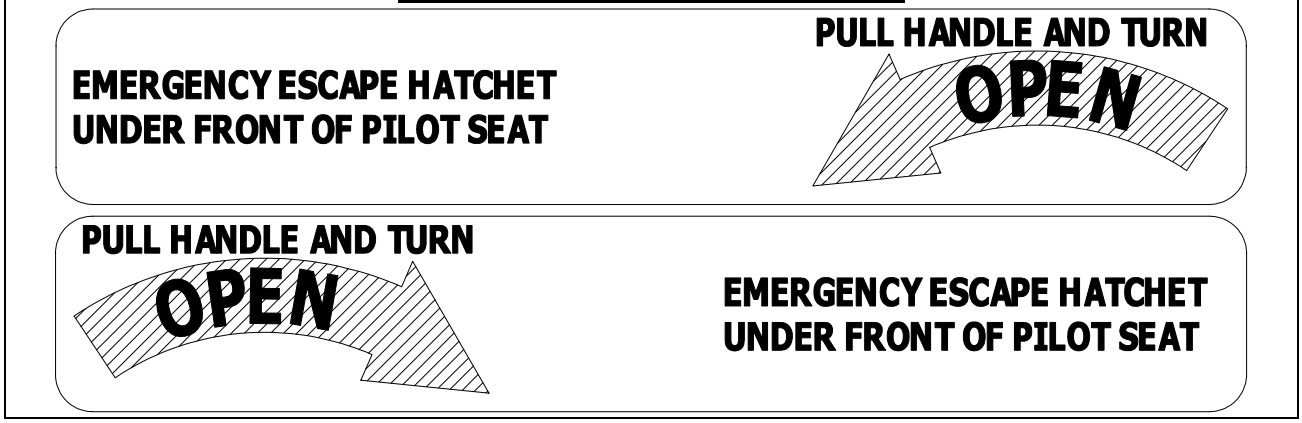
FLIGHT INTO KNOWN ICING PROHIBITED.

SPINS PROHIBITED.

APPROVED FOR DAY/NIGHT – VFR/IFR.

NO SMOKING

Near Pilot and Copilot Door Handles



Near Door Handle on Passenger Side

On Bottom of Baggage Compartment Door

TOTAL BAGGAGE WEIGHT 120 LBS., SHELF WEIGHT 20 LBS. MAX.
SEE WEIGHT AND BALANCE DATA FOR ADDITIONAL LOADING INSTRUCTIONS

On The Front of the Pilot's Seat Base Near Crash Ax

IN EMERGENCY
BREAK DOOR WINDOW

In Aft Cabin on Aft Baggage Bulkhead

EMERGENCY LOCATION TRANSMITTER LOCATED AFT OF THIS POINT. IT MUST BE MAINTAINED IN ACCORDANCE WITH THE FEDERAL AVIATION REGULATIONS

Under Left Rear Seat Next to Leveling Washer

AIRCRAFT LEVELING WASHER.
DO NOT REMOVE WASHER.

Under All Seats

SEAT BOTTOM CAVITY
MUST REMAIN CLEAR

On Parking Brake Handle

Near Airspeed Indicator

MANEUVERING SPEED: **148 KIAS (3400 LBS)**
127 KIAS (2500 LBS)

Near Airspeed Indicator

ABOVE 12,000 FT (PA) REDUCE: V_{NE} **5 KIAS/1000 FT**
V_{NO} **4 KIAS/1000 FT**

Near Manifold Pressure Gauge

DO NOT EXCEED 20”
MANIFOLD PRESSURE
BELOW 2200 RPM

On Magnetic Compass

For	N	30	60	E	120	150
Steer						
For	S	210	240	W	300	330
Steer						

DATE RADIOS ON

OR

For	N	30	60	E	120	150
Steer						
For	S	210	240	W	300	330
Steer						

Radios: On
Strobes: On

DATE
__/__/__

The magnetic direction indicator is calibrated for level flight with the engine, radios, and strobes operating.

Above Copilots Fresh Air Vent

Acrobatic Maneuvers:
Chandelles.....150 KIAS entry speed
Lazy Eights....150 KIAS entry speed
Steep Turns....150 KIAS entry speed
Stalls.....Slow Deceleration
SPINS PROHIBITED

Near the Left Dimmer Switch on the Pilot's Knee Bolster

ALT. STATIC

On the Back Lower Portion of the Front Seat Headrests
(Embroidered into the leather with red stitching)

NO SMOKING

EMERGENCY ESCAPE HATCHET
UNDER FRONT OF PILOT SEAT

On Forward Portion of Front Seat Center Armrest Near Fuel Selector

OFF
LIFT AND TURN

On Engine Instrument Panel Above Fuel Gauge

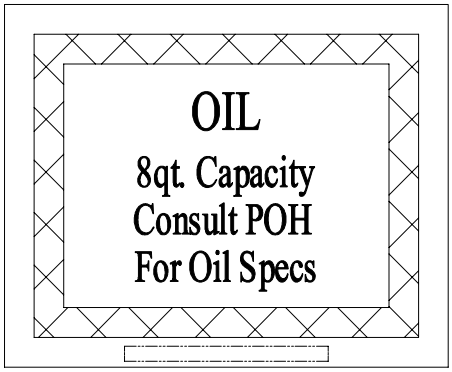
MAXIMUM FUEL IMBALANCE NOT TO EXCEED 10 GAL

On Engine Instrument Panel Near EGT/CHT
(when optional JPI digital engine scanner is installed)

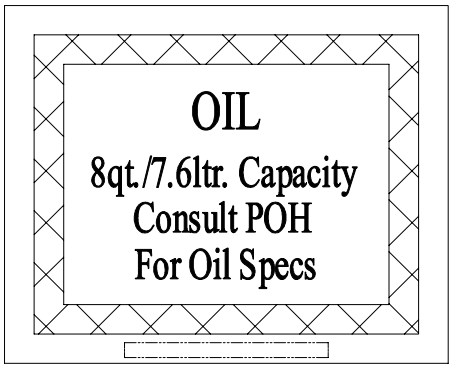
MAX
CHT
460°F

EXTERIOR PLACARDS

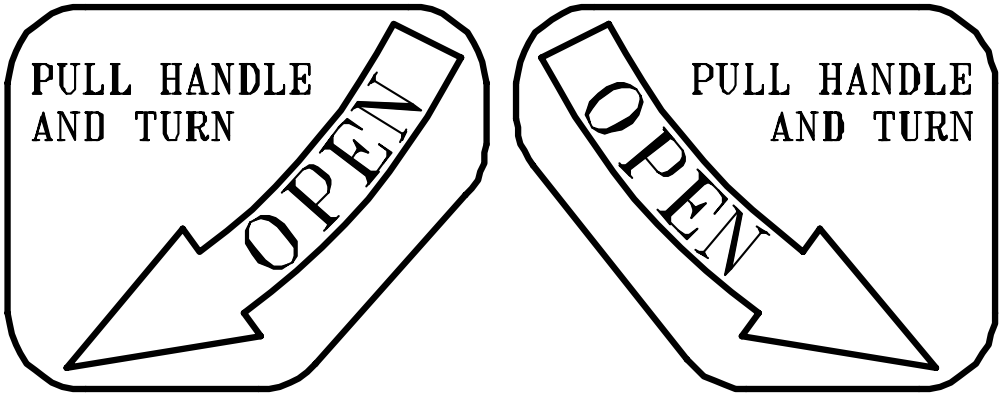
On Oil Filler Access Door



OR



Near Pilot and Passenger Door Handles



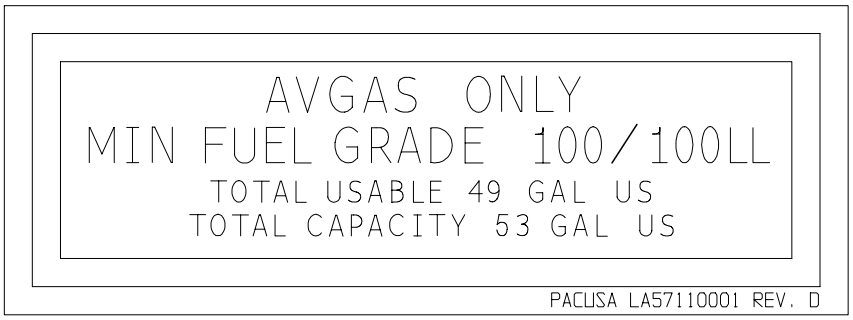
On Main Wheel Fairing

On Nose Wheel Fairings

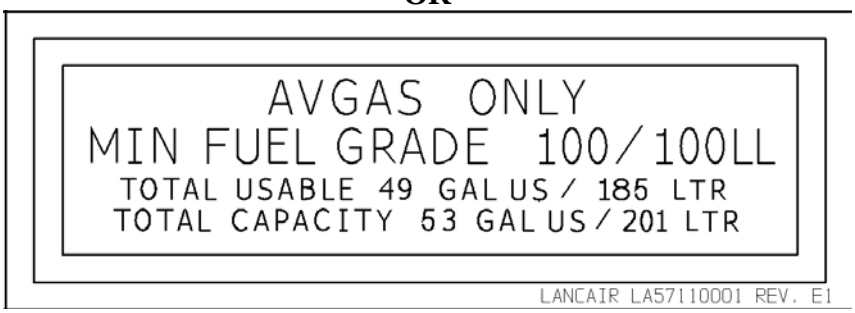
On Flaps Near Wing Root (Both Sides)

NO STEP

Near Fill Cap Of Fuel Tank



OR


AVGAS ONLY
MIN FUEL GRADE 100/100LL
TOTAL USABLE 49 GAL US / 185 LTR
TOTAL CAPACITY 53 GAL US / 201 LTR
LANCAIR LA57110001 REV. E1

Under Each Wing Near Fuel Drains

FOR DRAINING OF WING FUEL SUMP:
TO OPEN: PRESS CUP GENTLY INTO BOTTOM OF VALVE TO DRAIN REQUIRED AMOUNT OF FUEL.
TO CLOSE: REMOVE CUP AND VALVE WILL CLOSE.

TO DRAIN WING TANKS: REFER TO MAINTENANCE MANUAL.

On Exterior of Gascolator Door (Underside of Fuselage)

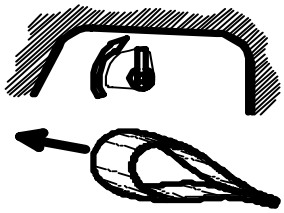
EMERGENCY
DOOR RELEASE
PRESS BUTTONS TO OPEN

On Interior of Gascolator

EMERGENCY DOOR RELEASE

Lift and turn cabin door handle.

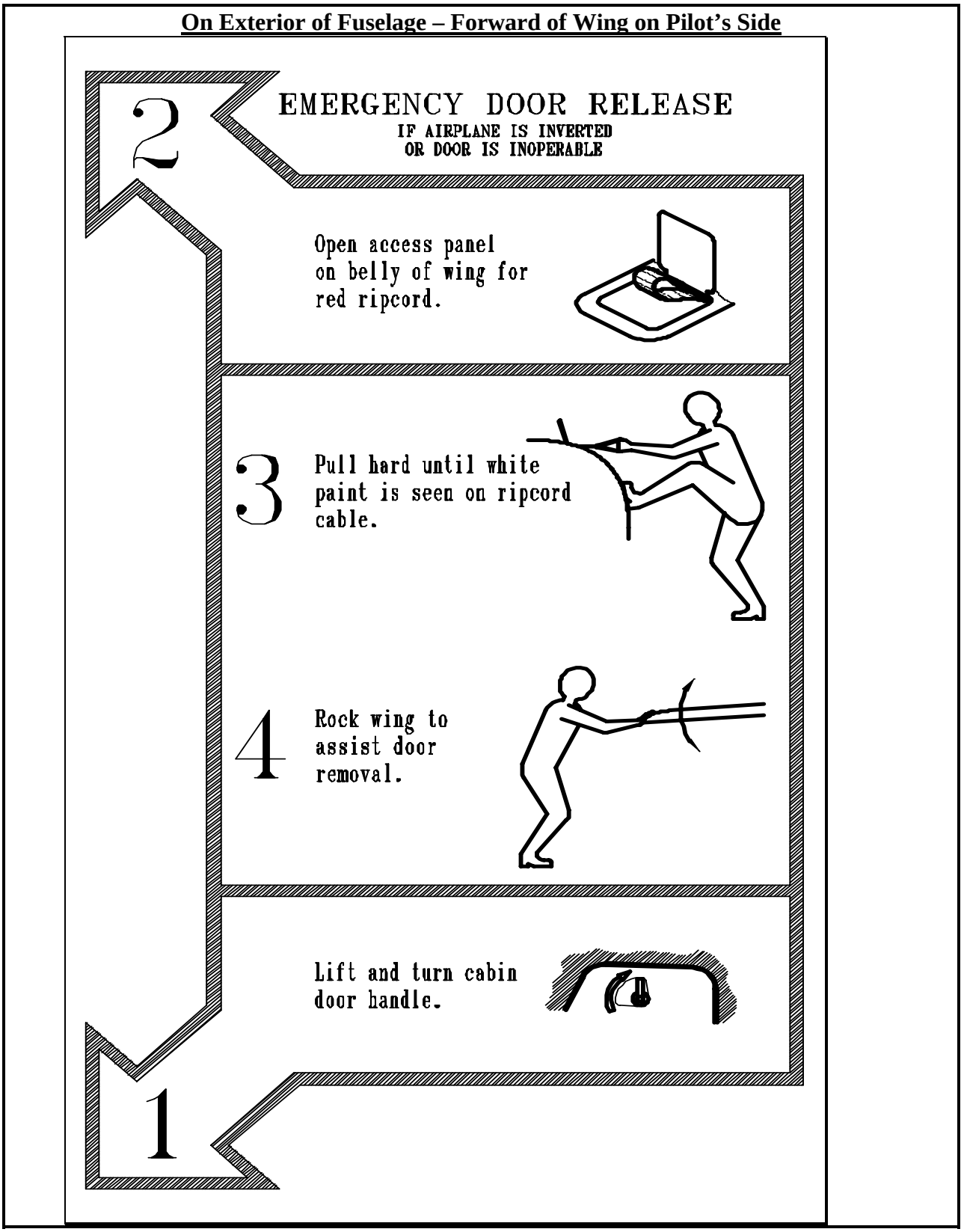
Pull red strap loop.



On Left Side Wing Fillet
(when optional ground power plug is installed)

12 VDC POWER CONNECTION

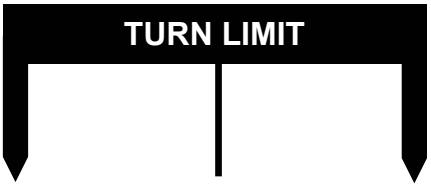
On Exterior of Fuselage – Forward of Wing on Pilot's Side


2
EMERGENCY DOOR RELEASE
IF AIRPLANE IS INVERTED
OR DOOR IS INOPERABLE
Open access panel on belly of wing for red ripcord.
3
Pull hard until white paint is seen on ripcord cable.
4
Rock wing to assist door removal.
Lift and turn cabin door handle.
1

On Exterior of Fuselage – Forward of Wing on Copilot's Side

On Top of Nose Wheel Fairing – (Pointing Aft)

On Forward Portion of Nose Gear Fairing



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Section 3
Emergency Procedures

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Section 3
Emergency Procedures

INTRODUCTION

The emergency procedures are included before the normal procedures, as these items have a higher level of importance. The owner of this handbook is encouraged to copy or otherwise tabulate the following emergency procedures in a format that is usable under flight conditions. Plastic laminated pages printed on both sides and bound together are preferable. Such a checklist is included as part of the airplane's delivery package. Complete Emergency Procedures Checklist shall be carried in the aircraft at all times in a location that is easily accessible to the pilot in command.

Many emergency procedures require immediate action by the pilot in command, and corrective action must be initiated without direct reference to the emergency checklist. Therefore, the pilot in command must memorize the appropriate corrective action for these types of emergencies. In this instance, the Emergency Procedures Checklist is used as a crosscheck to ensure that no items are excluded and is used only after control of the airplane is established. When the airplane is under control and the demands of the situation permit, the Emergency Procedures Checklist should be used to verify that all required actions are completed.

In all emergencies, it is important to communicate with Air Traffic Control (ATC) or the appropriate controlling entity within radio range. However, communicating is always secondary to controlling the airplane and should be done, if time and conditions permit, after the essential elements of handling the emergency are performed.

AIRSPEEDS FOR EMERGENCY OPERATIONS

Engine Failure After Takeoff		Maximum Glide (Flaps Up)	
Wing Flaps Up (Cruise Position)	106 KIAS	3400 lbs. (1542 kg) Gross Weight	106 KIAS
Wing Flaps Takeoff Position	93 KIAS	2500 lbs. (1134 kg) Gross Weight	94 KIAS
Maneuvering Speed		Minimum Rate of Descent (Flaps Up)	
3400 lbs. (1542 kg) Gross Weight	148 KIAS	3400 lbs. (1542 kg) Gross Weight	85 KIAS
2500 lbs. (1134 kg) Gross Weight	127 KIAS	2500 lbs. (1134 kg) Gross Weight	80 KIAS
Precautionary Landing		Approach Speed without Power	
(With engine power, flaps in the landing position)	78 KIAS	Wing Flaps Up (Cruise Position)	106 KIAS
		Wing Flaps Landing Position	90 KIAS

(Figure 3-1)

EMERGENCY PROCEDURES CHECKLISTS

ENGINE FAILURE DURING TAKEOFF

1. Throttle Control — SET TO IDLE
2. Brakes — APPLY STEADY PRESSURE (release momentarily if skidding occurs)
3. Wing Flaps — IN THE CRUISE POSITION
4. Mixture Control — SET TO IDLE CUT OFF
5. Ignition Switch — SET TO OFF
6. Master Switch — SET TO OFF
7. Fuel Selector Valve — SET TO OFF

ENGINE FAILURE IMMEDIATELY AFTER TAKEOFF (Below 400 Feet AGL)

1. Airspeed — 90 KIAS (with flaps in the up position)*
   90 KIAS (with flaps in the takeoff position)*
2. Mixture Control — SET TO IDLE CUT OFF
3. Fuel Selector Valve — SET TO OFF
4. Ignition Switch — SET TO OFF
5. Wing Flaps — IN THE LANDING POSITION (If airspeed and height above the ground permit full extension of flaps. Otherwise, the maximum flap extension practicable should be used depending on airspeed and height above the ground.)
6. Master Switch — SET TO OFF

*Obtain this airspeed if altitude permits; otherwise lower the nose, maintain current airspeed, and land straight ahead.

ENGINE FAILURE DURING CLIMB TO CRUISE ALTITUDE (Above 400 Feet AGL)

1. Airspeed — 106 KIAS (flaps in the up position)
2. Fuel Selector Valve — SET TO THE FULLER TANK (See Amplified Discussion.)
3. Mixture Control — SET TO RICH
4. Throttle Control — SET TO FULL OPEN
5. Backup Boost Pump — CHECK IN ARMED POSITION
   5.1. Engine Does Not Restart — Use *Emergency Landing Without Engine Power* checklist.
   5.2. Engine Restarts — Use the *Procedures After an Engine Restart* checklist.

ENGINE FAILURE DURING FLIGHT

1. Airspeed — 106 KIAS (flaps in the up position)
2. Fuel Selector Valve — SET TO THE FULLER TANK (See Amplified Discussion.)
3. Mixture Control — SET TO RICH
4. Throttle Control — SET TO FULL OPEN
5. Backup Boost Pump — SWITCH SET TO ARMED POSITION
6. Ignition Switch — VERIFY SET TO BOTH (Proceed to 6.2 or 6.1 as applicable)
   6.1. Engine Restarts — Use the *Procedures After an Engine Restar*t checklist.
   6.2. Engine Does Not Restart — Use *Emergency Landing Without Engine Power* checklist.

ENGINE FAILURE DURING DESCENT (Fuel Annunciator Illuminated)

1. Airspeed — 80 to 106 KIAS - See (Figure 3-3)
2. Mixture — SET TO RICH
3. Throttle — ADVANCED ABOUT ONE THIRD
4. Fuel Selector — SWITCH TANKS

5. Vapor Suppression — SET TO ON
   5.1. Engine Restarts — CLIMB TO SAFE ALTITUDE (Use *Procedures After an Engine Restar*t checklist.)
   5.2. Engine Does Not Restart – Do Steps 6 and 7
6. Throttle — SET TO FULL OPEN
7. Backup Boost Pump — SET TO ARMED POSITION
   7.1. Engine Restarts — CLIMB TO SAFE ALTITUDE (Use *Procedures After an Engine Restar*t checklist.)
   7.2. Engine Does Not Restart — Use *Emergency Landing Without Engine Power* checklist if altitude permits.

PROCEDURES AFTER AN ENGINE RESTART

1. Airspeed — APPROPRIATE TO THE SITUATION
2. Throttle Control — REDUCE AS REQUIRED
3. Failure Analysis — DETERMINE CAUSE (Proceed to 3.1 or 3.2 as applicable.)
   3.1. Improper Fuel Management — If the engine failure cause is improper fuel management, set the backup boost pump to OFF and resume flight.
   3.2. Engine Driven Fuel Pump Failure — If fuel management is correct, failure of the engine driven fuel pump or a clogged fuel filter is probable. If practicable, reduce power to 75% or less and land as soon as possible. Do not set the mixture to rich for descent or landing. Refer to the amplified discussion on page 3-15.

WARNING

If the backup boost pump is in use during an emergency, proper leaning procedures are important. During the descent and approach to landing phases of the flight, DO NOT set the mixture to rich as prescribed in the normal before landing procedures, and avoid closing the throttle completely. If a balked landing is necessary, coordinate the simultaneous application of mixture and throttle. Please see amplified discussion on page 3-15.

EMERGENCY LANDING WITHOUT ENGINE POWER

1. Approach Airspeed — 90 KIAS (Full Flaps or Takeoff Flaps)
2. Seat Belts and Shoulder Harnesses — FASTENED AND SECURE
3. Loose objects — SECURE
4. Backup Boost Pump and Vapor Suppression — BOTH SET TO OFF
5. Mixture Control — SET TO IDLE CUT OFF
6. Fuel Selector Valve — SET TO OFF
7. Electrical and Avionics Master Switches — SET TO OFF
8. Ignition Switch — SET TO OFF
9. Wing Flaps — AS REQUIRED (Full flaps recommended for landing)
10. Master Switch — SET TO OFF
11. Landing Flare — INITIATE AT APPROPRIATE POINT TO ARREST DESCENT RATE, AND TOUCHDOWN AT NORMAL LANDING SPEEDS
12. Stopping — APPLY HEAVY BRAKING

CAUTION

At the forward CG limit, slowing below 80 KIAS prior to the flare, with idle power and full flaps, will create a situation of limited elevator authority; an incomplete flare may result.

EMERGENCY LANDING WITH THROTTLE STUCK AT IDLE POWER

1. Approach Airspeed — 90 KIAS (full flaps or takeoff flaps)
2. Seat Belts and Shoulder Harnesses — FASTENED AND SECURE
3. Loose objects — SECURE
4. Electrical and Avionics Master Switches — SET TO OFF
5. Backup Boost Pump and Vapor Suppression — BOTH SET TO OFF
6. Wing Flaps — AS REQUIRED (full flaps recommended)
7. Engine Shutdown — DELAY AS LONG AS PRACTICABLE (Then follow steps 8 - 13.)
8. Master Switch — SET TO OFF
9. Fuel Selector Valve — SET TO OFF
10. Mixture Control — SET TO IDLE CUT OFF
11. Ignition Switch — SET TO OFF
12. Landing Flare — INITIATE AT APPROPRIATE POINT TO ARREST DESCENT RATE, AND TOUCH DOWN AT NORMAL LANDING SPEEDS
13. Stopping — APPLY HEAVY BRAKING

WARNING

Two special conditions associated with forced landings are specifically applicable to the Columbia 300 (and are different from many other General Aviation airplanes). These differences must be clearly understood.

1. **Since the trim tabs are electrically operated, setting the master switch to OFF should be delayed until the pilot is certain that further use of the trim, particularly the elevator trim, is not required.**
2. **Do not open the cabin doors in flight. The air loads placed on the doors in flight will damage them and can cause separation from the airplane. A damaged or separated door will alter the flight characteristics of the airplane and possibly damage other control surfaces.**

PRECAUTIONARY LANDING WITH ENGINE POWER

1. Seat Belts and Shoulder Harnesses — FASTENED AND SECURE
2. Loose Objects — SECURE
3. Wing Flaps — SET TO TAKEOFF POSITION
4. Airspeed — 95 to 105 KIAS
5. Select a landing area — FLY OVER AREA (Determine wind direction and survey terrain. Note obstructions and most suitable landing area. Climb to approximately 1000 feet above ground level (AGL), and retract flaps when at a safe altitude and airspeed. Set up a normal traffic pattern for a landing into the wind.)
6. Electrical and radio switches — SET TO OFF
7. Wing flaps — SET TO LANDING POSITION (when on final approach)
8. Airspeed — 78 KIAS
9. Master Switch — SET TO OFF (just before touchdown)
10. Landing — LAND AS SLOW AS PRACTICABLE IN A NOSE UP ATTITUDE
11. Ignition Switch — SET TO OFF
12. Stopping — APPLY HEAVY BRAKING

DITCHING

1. Radio — MAKE DISTRESS TRANSMISSION (Set transponder code 7700 and transmit a Mayday distress condition. Give estimated position and intentions.)
2. Loose Objects — SECURE
3. Seat Belts and shoulder harnesses — FASTENED AND SECURE

4. Wing Flaps — SET TO LANDING POSITION
5. Descent — ESTABLISH MINIMUM DESCENT (Set airspeed to 65 KIAS, and use power to establish minimum descent, ±200 feet/minute. See 7.2 below for landings without power.)
6. Approach — In high winds and heavy swell conditions, approach into the wind. In light winds and heavy swell conditions, approach parallel to the swell. If no swells exist, approach into the wind.
7. Touchdown Alternatives
   7.1. Touchdown (**Engine power available**) — Maintain minimum descent attitude. Apply power to slow or stop descent if necessary. When over a suitable touchdown area, reduce power and slowly settle into the water in a nose up attitude near the stalling speed.
   7.2. Touchdown (**No engine power available**) — Use an 80 to 85 KIAS approach speed down to the flare-out point, and then glide momentarily to get a feel for the surface. Allow the airplane to settle into the water in a nose up attitude near the stalling speed.
8. Evacuation of airplane — Evacuate the airplane through the pilot or passenger doors. It may be necessary to allow some cabin flooding to equalize pressure on the doors. If the pilot or passenger doors are inoperative, use the crash ax/hatchet (located below the front seat on the pilot's side) to break either window on the main cabin doors. For more information see the Crash Ax discussion on page 3-28.
9. Flotation devices — DEPLOY FLOTATION DEVICES

NOTE

Over glassy smooth water, or at night without sufficient light, even experienced pilots can misjudge altitude by 50 feet or more. Under such conditions, carry enough power to maintain a nose up attitude at 10 to 20 percent above stalling speed until the airplane makes contact with the water.

NOTE

In situations that require electrical system shutdown under poor ambient light conditions, cabin illumination is available through use of the overhead flip lights. The flip lights are connected directly to the battery and will operate provided there is adequate battery power.

ENGINE FIRE ON THE GROUND DURING STARTUP

If flames are observed in the induction or exhaust system, use the following procedures.

1. Mixture Control — SET TO IDLE CUT OFF
2. Throttle Control — SET TO FULL OPEN
3. Starter Switch — HOLD IN CRANKING POSITION (until fire is extinguished)
4. Parking Brake — RELEASE (If parking brake is engaged)
5. Fire Extinguisher — OBTAIN FROM CABIN AND EVACUATE AIRPLANE
6. Follow-up — If fire is present, extinguish it. Inspect for damage and make the appropriate repairs or replacements.

NOTE

Sometimes a fire will occur on the ground because of improper starting procedures. If circumstances permit, move the airplane away from the ground fire by pushing aft on the horizontal stabilizer, and then extinguish the ground fire. This must only be attempted if the ground fire is nominal and sufficient ground personnel are present to move the airplane.

IN-FLIGHT ENGINE FIRE

1. Throttle Control — SET TO CLOSED
2. Mixture Control — SET TO IDLE CUT OFF
3. Fuel Selector Valve — SET TO OFF
4. Heating and Ventilation System — SET TO OFF
5. Master Switch — SET TO OFF
6. Airspeed — 179 KIAS (If fire is not extinguished at this speed, increase speed to a level that extinguishes the fire.)
7. Landing — PERFORM A FORCED LANDING (See procedures on page 3-5.)

IN-FLIGHT ELECTRICAL FIRE

1. All Heating and Ventilating Controls — SET TO OFF
2. Master Switch — SET TO OFF
3. All Avionics and Electrical Switches — SET TO OFF
4. Trim System Switch — SET TO OFF
5. Fire Extinguisher — DISCHARGE IN AREA OF THE FIRE
6. Post Fire Details — OPEN VENTILATION (if fire is extinguished)
7. Phased System Power-up — Determine if electrical power is necessary for the safe continuation of the flight. If it is required, proceed with items 8 through 10 below.
8. Standby Battery — ACTIVATE (Break safety wire by raising guard – press latching switch)
9. Radios/GPS — SET TO ON (After Com/Nav is on, wait a few minutes before activating GPS. Then ensure GPS unit functions normally, i.e., no indications of smoke or fire.)
10. Land as soon as possible.

IN-FLIGHT CABIN FIRE (Fuel/Hydraulic Fluid)

1. All Heating and Ventilating Controls — SET TO OFF
2. Master Switch — SET TO OFF
3. Fuel Selector — SET TO OFF
4. Fire Extinguisher — DISCHARGE IN AREA OF THE FIRE
5. When Fire is Extinguished — VENTILATE CABIN (Turn on master switch, cabin fan, open ventilation, and deactivate door seals)
6. Post Fire Details — FOLLOW "EMERGENCY LANDING WITHOUT ENGINE POWER" CHECKLIST

WARNING

The fire extinguishing substance is toxic and the fumes must not be inhaled for extended periods. After discharging the extinguisher, the cabin must be ventilated. If oxygen is available, put masks on and start oxygen flow. Oxygen must only be used after it is determined that the fire is extinguished.

IN-FLIGHT WING FIRE

1. Navigation Lights Switch — SET TO OFF
2. Pitot Heat Switch — SET TO OFF
3. Strobe/Position Lights Switch — SET TO OFF
4. Landing Light — SET TO OFF
5. Flight Action — Perform an intense sideslip to keep the flames away from the fuel tank and the cabin. The sideslip may also extinguish the fire. Land the airplane as soon as possible. Use wing flaps only if essential for a safe landing.

NOTE

In an emergency requiring the shutdown of electrical power, such as a fire in flight, enabling the Standby Battery permits use of the flaps. The guarded and wire-sealed switch is located on the light row of the circuit breaker panel. Breaking the copper wire on the switch guard, raising the switch guard, and depressing and locking the push-button switch, activates the standby system. See pages 3-23 and 7-42 for more details.

WARNING

When flying in areas where inadvertent icing is possible, i.e., areas of visible moisture that are not forecasted to have icing conditions, turn on the pitot heat at least five minutes before entering the areas of visible moisture.

INADVERTENT ICING

1. Detection — CHECK SURFACES (The stall strips and wing cuffs are good inspection points for evidence of structural icing.
2. Pitot Heat — SET TO ON
3. Course — REVERSE COURSE
4. Altitude — CHANGE (to a level where the temperature is above freezing)
5. Defroster — Divert all heated air to the defroster
6. Propeller Control — INCREASE (Higher propeller speeds will mitigate ice accumulation.)
7. Manifold Pressure — MONITOR (A drop in manifold pressure may be an indication of induction icing; increase throttle settings as required.)
8. Heated Induction Air — SET TO ON (Operate if induction icing is evident or suspected.)
9. Alternate Static Source — (Open if static source icing is evident or suspected)
10. Flight Characteristics — ADD MARGIN OF SAFETY (An ice buildup on the wings and other surfaces will increase stalling speeds. Add a margin to approach and landing speeds.)
11. Approach Speed — Appropriate for the amount of ice accumulation and flap setting. If there is a heavy ice buildup on the windshield, a gentle forward slip or small S-turns may improve forward visibility by allowing use of the side windows.
12. Landing Attitude — LIMITED FLARE (Land at a higher speed and in a flat attitude sufficient to prevent the nose wheel from touching the ground first.)

LANDING WITH A FLAT MAIN TIRE

1. Approach — NORMAL
2. Wing Flaps — SET TO LANDING POSITION
3. Touchdown — Touch down on the inflated tire first and maintain full aileron deflection towards the good tire, keeping the flat tire off the ground for as long as possible. Be prepared for abnormal yaw in the direction of the flat tire.

LANDING WITH A FLAT NOSE TIRE

1. Approach — NORMAL
2. Wing Flaps — SET TO LANDING POSITION
3. Touchdown — Touch down on the main landing gear tires first. Maintain sufficient back elevator deflection to keep the nose tire off the ground for as long as possible.

ELECTRICAL SYSTEM OVERCHARGING* (Alternator stays on-line and voltmeter has high voltage indication)

1. Alternator Switch — SET TO OFF
2. Nonessential Electrical and Avionics Equipment — SET TO OFF

3. Flight — Depending on conditions, the flight shall be terminated as soon as possible or practicable.

NOTE

The voltage regulator will trip the alternator off-line in conditions of over voltage, i.e., greater than 16.0 volts. If this happens the annunciator panel will indicate the alternator is out. The most likely cause is transitory spikes or surges tripped the alternator off-line.

ELECTRICAL SYSTEM DISCHARGING (Ammeter shows a discharging condition and the alternator annunciator indicates "Alt Out")

1. Avionics Master Switch — SET TO OFF
2. Alternator Switch — SET TO OFF
3. Alternator Switch — SET TO ON
4. Alternator annunciator Light Alternatives (Follow either 4.1 or 4.2 below.)
   - 4.1. Annunciator Light Condition (**Light is off**) - If after recycling the system, the alternator annunciator light stays off, set the avionics master switch to ON and proceed with normal operations.
   - 4.2. Annunciator Light Condition (**Light is on**) - If after recycling the system the alternator annunciator light does not go out or trips the alternator off-line again, follow steps 5 - 8 below.
5. Alternator — SET TO OFF
6. Avionics Master Switch — SET TO ON
7. Nonessential Avionics and Electrical Equipment — SET TO OFF
8. Flight — Depending on conditions, the flight must be terminated as soon as possible or practicable.

COMPLETE ELECTRICAL FAILURE (Battery is totally discharged or provides unreliable instrument, lighting, and avionics indications)

1. Master Switch — SET TO OFF
2. Standby Battery Switch Guard Sealing Wire — BREAK WIRE AND RAISE GUARD (See amplified discussion on page 3-23.)
3. Standby Battery Switch — DEPRESSED AND LATCHED
4. Flight — LAND AS SOON AS PRACTICABLE OR AS SOON AS POSSIBLE (depending on flight conditions)

WARNING

During a total electrical failure, with the main battery inoperative, the rudder limiter and the stall warning indicator will not work. In this situation, the pilot must give special attention to maintenance of proper airspeeds, particularly when operating near the airplane's stalling speed.

NOTE

If the electrical system fails and the main battery is totally discharged, the standby battery will supply power to the GPS, Com 1, the instrument floodlights, the turn coordinator, the HSI (if installed), the blind encoder, and the ECS servo for at least 30 minutes. The standby battery also powers the flaps. However, they should be used only when needed just before landing. If the standby battery has been in operation for 30 minutes, the flaps may not operate.

RUDDER LIMITER MALFUNCTION (System will not disengage and/or annunciator is lit.)

1. Left Rudder Pedal — VERIFY RUDDER LIMITER IS ENGAGED (If the system is not engaged, the annunciator is faulty. In this situation, proceed to step No. 5 below.)
2. Rudder Limiter Circuit Breaker — PULLED (Wait for approximately 30 seconds.)
3. Rudder Limiter Circuit Breaker — IN (If rudder limiter is still engaged, do step 4. If rudder limiter disengages, proceed to Step 5.)
4. Rudder Limiter Test Switch — SET TO TEST POSITION
5. Rudder Limiter Circuit Breaker — PULLED (Follow step 6 or 7 as applicable.)
6. Rudder Limiter Engaged — LAND AS SOON AS POSSIBLE
7. Rudder Limiter Disengaged — LAND AS SOON AS PRACTICABLE
8. Landing with the **Rudder Limiter Disengaged** — Perform a normal landing, and avoid operations near the airplane's stalling speed.
9. Landing with **Rudder Limiter Engaged** — Airport selection should be based in part on the runway length available and the amount of crosswind component. A crosswind from the left is preferable. The maximum demonstrated right crosswind component with the rudder limiter engaged is 6 knots.

RUDDER LIMITER FAILURE (The system is inoperative)

1. Rudder Limiter Circuit Breaker — CHECK IN (If the circuit breaker is out, reset and test for proper operations. If system is functioning normally, proceed with the flight. If the circuit breaker is IN, proceed to step No. 2 below.
2. Rudder Limiter Circuit Breaker — PULLED
3. Flight — LAND AS SOON AS PRACTICABLE
4. Landing with the rudder limiter disengaged — Perform a normal landing, and avoid operations near the airplane's stalling speed.

RUNAWAY TRIM (sudden and unexplained changes in control pressures)

1. Trim Tab System ON/OFF Switch — SET TO OFF TO DISABLE THE SYSTEM
2. Power Settings — REDUCE TO 50% BHP OR LESS (Depending on conditions)
3. Airspeed — 100 to 110 KIAS (Depending on conditions)
4. Circuit Breakers — PULL BOTH TRIM BREAKERS TO THE OFF POSITION
5. Flight Plan — TERMINATE AS SOON AS PRACTICABLE OR POSSIBLE (This depends on the magnitude of control pressure(s) required to maintain a normal flight attitude.)
6. Landing — PREPARE FOR CONTROL PRESSURE CHANGES (When power is reduced and airspeed decays, there can be substantial changes in the required control pressures.)

WARNING

In a runaway trim emergency the two most important considerations are to (1) IMMEDIATELY turn off the trim system and (2) maintain control of the airplane. The airplane will not maintain level flight and/or proper directional control without pilot input to the affected flight control(s). If excessive control pressure is required to maintain level flight, the flight must be terminated as soon as possible. Pilot fatigue can be increased significantly in this situation with the potential for making the landing difficult.

PARTIAL RESTORATION OF A DISABLED TRIM SYSTEM

1. Trim Tab On/Off Switch — SET TO THE ON POSITION
2. Malfunction Analysis — DETERMINE AXIS OF MALFUNCTION
3. Circuit Breaker(s) — SET PROPERLY FUNCTIONING AXIS BREAKER TO ON

BROKEN OR STUCK THROTTLE CABLE (with enough power for continued flight)

1. Continued Flight — LAND AS SOON AS POSSIBLE
2. Airport Selection — ADEQUATE FOR POWER OFF APPROACH
3. Descent — CONTROL WITH MIXTURE (Avoid extended power off descents which could result in cold soaking.)
4. Fuel Selector — FULLER TANK
5. Approach Airspeed — 93 KIAS (With flaps in the up position)
   90 KIAS (With flaps in the landing position)
6. Seat Belts — FASTENED AND SECURE
7. Loose objects — SECURE
8. Flaps — AS REQUIRED (Full flaps should be extended only when reaching the runway is assured.)
9. Mixture (Reaching runway is assured) — MIXTURE IDLE CUT-OFF
10. Touchdown — MAIN WHEELS FIRST, GENTLY LOWER NOSE WHEEL
11. Braking — AS REQUIRED

SOMETHING STUCK IN OR INTERFERING WITH A DOORJAMB

1. Affected Door — DO NOT OPEN THE DOOR IN FLIGHT

WARNING

Do not open any of the airplane doors in flight. The doors are not designed to be opened in flight; subsequent airloads on an opened door will forcefully pull it completely open and detach it from the airplane.

2. Flight — LAND AS SOON AS PRACTICABLE

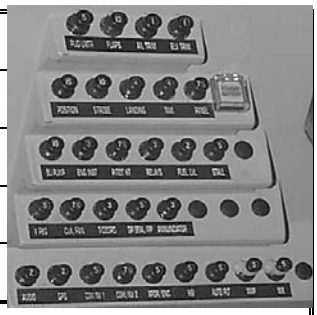
EVACUATING THE AIRPLANE

1. Seat Belts — REMOVE (Do not remove seat belts until the airplane comes to a complete stop, unless there is a compelling reason to do otherwise. If the onset of the emergency is anticipated, ensure the seat belt is as tight as possible. See discussion on page 3-27.)
2. Doors — USE BOTH IF POSSIBLE AND REQUIRED (Do not open doors in flight.)
3. Crash Ax — USE AS REQUIRED (If the cabin doors are inoperable, break out a cabin door window. See crash ax discussion on page 3-28.)
4. Exiting the Airplane — AS APPROPRIATE (If possible, use both doors. Generally, it is best to go aft unless there are compelling reasons to do otherwise. See discussion on page 3-27.)
5. Assistance — AS APPROPRIATE (If possible, necessary, and not life threatening, render assistance to others in the airplane.)
6. Congregating Point — DESIGNATE (Pilot and passengers should have a designated congregating point, say 100 feet aft of the airplane.)

CIRCUIT BREAKER PANEL

Many of the above emergency procedures involve resetting or pulling circuit breakers, which requires a good understanding of the panel's location and layout. The circuit breaker panel is located forward of the pilot's front seat on the lower side-panel. To ensure the pilot knows the location of each circuit breaker, a table is provided in (Figure 3-2). Note that the circuit breaker rows are approximately grouped. The first row is flight controls; the second row is for lighting and the standby battery switch; rows three and four are basically for electrical equipment and instruments; and the last row contains the avionics equipment. See (Figure 7 - 13) on page 7-43 for a diagram of the electrical system and a list of circuit breaker values.

	Rudder Limiter	Flaps	Aileron Trim	Elevator Trim							
Position Lights	Strobe Lights	Landing Lights	Taxi Lights	Panel Lights	Standby Battery Switch						
Backup Pump	Engine Instruments	Pitot Heat	Relays	Fuel Level	Stall Warning	●					
Voltage Regulator	Clock/ Cabin Fan	Turn Coordinator†		Door Seal/ Power Point	Annunciator Panel	●	●	●			
Audio Amplifier	GPS	Comm/ Nav No. 1	Comm/ Nav No. 2	Transponder/ Encoder	HSI	Auto -pilot	Map	WX	●		



Note 1: A ● indicates that the circuit breaker position is unused, but reserved for future optional equipment.

Note 2: The actual arrangement may vary slightly depending on the optional equipment installed.

† The ECS servomotor shares a 3 amp circuit breaker with the turn coordinator.

(Figure 3-2)

AMPLIFIED EMERGENCY PROCEDURES

ENGINE FAILURE AND FORCED LANDINGS

General – The most important thing in any emergency is to maintain control of the airplane. If an engine failure occurs during the takeoff run, the primary consideration is to safely stop the airplane in the remaining available runway. The throttle is reduced first to prevent momentary restarting of the engine. Raising the flaps reduces lift, which improves ground friction and facilitates braking. In emergencies involving loss of power, it is important to minimize fire potential, which includes shutting down or closing the electrical and fuel systems.

Engine Failure After Takeoff (Below 400 feet AGL) – With an engine failure immediately after takeoff, time is of the essence. The most important consideration in this situation is to maintain the proper airspeed. The airplane will be in a climb attitude and when the engine fails, airspeed decays rapidly. Therefore, the nose must be lowered immediately and a proper glide speed established according to (Figure 3-3). It may not be possible to accelerate to the best distance glide speed due to altitude limitations. In this instance, lower the nose, maintain current airspeed, and land straight ahead.

It is unlikely there will be enough altitude to do any significant maneuvering; only gentle turns left or right to avoid obstructions should be attempted. If there are no obstructions, it is best to land straight ahead unless there is a significant crosswind component. Flaps should be applied if airspeed and altitude permit since they can provide a 10+ knot reduction in landing speed.

Engine Failure After Takeoff (Above 400 feet AGL) – With an engine failure after takeoff, there may be time to employ modified restarting procedures. Still, the most important consideration in this situation is to maintain the proper airspeed. The airplane will be in a climb attitude and when the engine fails, airspeed decays rapidly. Therefore, the nose must be lowered immediately and a proper glide speed established according to (Figure 3-3). It may not be possible to accelerate to the best distance glide speed due to altitude limitations. In this instance, lower the nose, maintain current airspeed, and land straight ahead.

In-Flight Engine Failure – The extra time afforded by altitude may permit some diagnosis of the situation. The first item is to establish the proper rate of descent at the best glide speed for the situation, as shown in (Figure 3-3). If altitude and other factors permit, an engine restart should be attempted. The checklist items 2 through 6, Engine Failure During Flight, on page 3-4, ensure that the fuel supply and ignition are available. The most likely cause of engine failure is poor fuel management. The two more frequent errors are forgetting to change the fuel selector or, during an extended descent, failure to readjust the mixture.

	Best Distance Glide (Most Distance)	**Min. Rate Glide (Min. rate of descent)**
Gross Weight	KIAS	KIAS
3400 lbs. (1542 kg)	106	85
2500 lbs. (1134 kg)	93	80

(Figure 3-3)

Best Glide Speed Versus Minimum Rate of Descent Speed – The best distance glide speed will provide the most distance covered over the ground for a given altitude loss, while the minimum rate of descent speed, as its name suggests, will provide the least altitude lost in a given time period. The best distance glide speed might be used in situations where a pilot, with a

engine failure but several thousand feet above the ground, is attempting to reach a distant airport. The minimum rate of descent could be used in a situation when the pilot is over the desired landing spot and wishes to maximize the time aloft for checklists and restart procedures.

Emergency Backup Boost Pump – The backup boost pump is intended for use during an emergency situation when failure of the engine driven pump has occurred. The switch that controls this operation is on the rocker switch panel. The labeling on the switch reads BACKUP PUMP ARMED. The switch is normally in the ARMED position for takeoff and climb to cruise altitude and in the OFF position for cruise, descent, and approach to landing. The top of the switch is engraved with the word OFF and is readable only when the switch is off.

If the engine driven pump malfunctions, and the backup boost pump is in the ARMED position, the backup fuel pump will turn on automatically when the fuel pressure is less than about 5.5 psi. This condition will also activate a red FUEL light in the annunciator panel. When the red FUEL light in the annunciator panel illuminates, there may be an audible degradation in the smoothness of engine operation. With the backup pump operating, fuel is not as precisely metered, compared to the normal engine driven system, and frequent mixture adjustments are necessary when changes are made to the power settings. In particular, avoid large power changes, since an over-rich or over-lean mixture will affect the proper operation of the engine.

In general, as power is reduced from the 75% of BHP level, there must be a corresponding leaning of the mixture. On an approach to landing, the normal checklist procedures must be modified to exclude setting the mixture to full rich. It is best to make a partial power approach with full flaps, and only reduce power when over the runway. If a balked landing is necessary, coordinate the simultaneous application of mixture and throttle.

At power settings above the 75% level the problem is operating at too lean of a mixture. At full throttle, the engine will produce approximately 79% of its rated BHP. In this situation, the fuel-air mixture is lean of peak, and higher cylinder head temperatures and EGT readings will result from extended use in the condition. Full throttle operations must be kept to a minimum and only used to clear an obstacle, execute a balked landing, or other similar situations that require use of all available power.

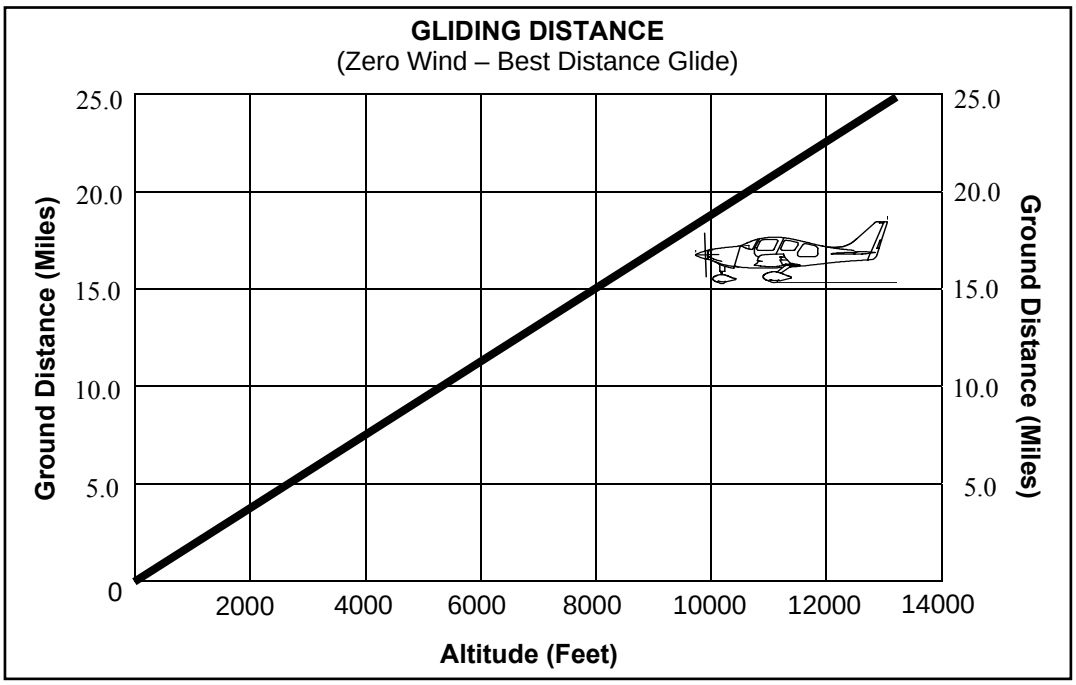
Critical Issues (**Backup Boost Pump)** – One of the more critical times for an engine driven boost pump failure is when the engine is at idle power, such as a descent for landing. There are two reasons that make this situation more serious compared with other flight phases. (1) The airplane is more likely to be at a lower altitude, which limits time for detection, analysis, and corrective measures. (2) With the engine at idle power, there is no aural indication of engine stoppage. If the engine failure is a result of fuel starvation with a fuel pressure less than 5.5 psi, then the FUEL annunciator will provide a visual indication.

There is a latching relay that basically controls the logic of the system. For example, it turns the backup pump on, when the backup boost switch is in the ARMED position and the fuel pressure drops below 5.5 psi. Moreover, if the backup system is automatically turned on while the vapor suppression is on, it will suspend operation of this function. Most functions in the system are integrated with the latching relay, and failure of this relay will result in failure of the system. However, the FUEL annunciator light is independent of this system and will operate anytime the fuel pressure is less than 5.5 psi.

In a situation involving a double failure, i.e., a malfunction of the engine driven pump and the latching relay, the FUEL annunciator will illuminate. Since the primer and backup boost pump are one and the same, the pilot can bypass the latching relay by holding the primer switch in the depressed position. In this particular situation, this would restore engine power and permit continuation of the flight and a landing, which must be done as soon as possible. Of course, the pilot must continually depress the primer switch, which increases the cockpit work load.

CAUTION

Do not shut down an engine for practice or training purposes. If engine failure is to be simulated, it shall be done by reducing power. A few minutes of exposure to temperatures and airspeeds at flight altitudes can have the same effect on an inoperative engine as hours of cold-soaking in sub-Arctic conditions.



(Figure 3-4)

Engine Restarts - If the engine restarts, two special issues must be considered: (1) If the airplane was in a glide for an extended period of time at cold ambient air temperatures, the engine should be operated at lower RPM settings for a few minutes until the oil and cylinder temperatures return to normal ranges if possible. (2) If the engine failure is not related to pilot error, i.e., poor fuel management or failure to enrich the mixture during a long descent from a high altitude, then a landing should be made as soon as practicable to determine the cause of the engine failure.

Engine Does Not Restart - If the engine does not restart, then a forced landing without power must be completed as detailed earlier in this section on page 3-5, Emergency Landing Without Engine Power. Maintaining the best distance glide speed provides the maximum distance over the ground with the least altitude loss. The preceding graph (Figure 3-4) provides information on ground distance covered for a given height above the ground. At the best distance glide speed, a good rule of thumb, under zero wind conditions, is to anticipate approximately 1¾ miles over the ground for each 1000-foot increment above the ground**.**

Forced Landing with the Throttle Stuck in the Idle Position – If the throttle is stuck at idle or near idle power, then a forced landing must be performed. The procedures are somewhat similar to those associated with a complete power loss. However, powerplant shutdown should be delayed as long as safely practicable since the stuck throttle may be spontaneously cured. Changes in altitude, temperature, and other atmospheric conditions associated with the descent may combine to alleviate the stuck throttle condition. On the other hand, the problem could be the result of a broken throttle cable, which has no immediate cure. Regardless of the cause, the pilot lacks both the time and resources to properly analyze the cause. Running the engine until the last practicable moment, within the confines of safety, is the most prudent course of action.

It is possible that the throttle may stick at a power setting that is above idle, but at insufficient brake horsepower to sustain level flight. At the same time, this condition may restrict the desired rate of descent. In this situation, the pilot can set the mixture control to idle cut-off to momentarily stop the operation of the engine. If cylinder head temperatures fall below 240º, restart the engine as necessary by enriching the mixture.

Stuck Throttle with Sufficient Power to Sustain Flight – If the throttle sticks at a power setting that produces enough power for continued flight then a landing should be made as soon as possible. If the airplane is near the ground, climb to an altitude that provides a greater margin of safety, provided there is sufficient power to do so. Do not begin the descent for land until the airplane is near or over the airport. Again, as mentioned in the previous paragraph, the pilot can set the mixture control to idle cut-off to momentarily stop the operation of the engine. If cylinder head temperatures fall below 240º, restart the engine as necessary by enriching the mixture. A checklist for a stuck throttle condition that will sustain flight is discussed on page 3-12.

FLIGHT CONTROLS MALFUNCTIONS

General – The elevator and aileron controls are actuated by pushrods, which provide direct positive response to the input of control pressures. The rudder is actuated by cable controls. The pushrod system makes the likelihood of a control failure in the roll and pitch axis remote.

Aileron or Rudder Failure – The failure of the rudder or ailerons does not impose a critical situation since control around either the vertical and longitudinal axes can still be approximately maintained with either control surface. Plan a landing as soon as practicable on a runway that minimizes the crosswind component. Remember that the skidding and slipping maneuvers inherent in such an approach will increase the airplane's stall speed, and a margin for safety should be added to the approach airspeed.

Elevator Failure – In the event of a failure of the elevator control system the airplane can be controlled and landed using the elevator trim tab. The airplane should be landed as soon as possible. En route, establish horizontal flight at 65% to 75% power. When within 15 miles of the landing airport, slow to 120 KIAS, set the flaps to the takeoff position, and establish a timed shallow descent. Adjust the descent with power to enter the downwind leg at or slightly above pattern altitude. Make a slightly wider than normal pattern so more time is provided for setup. On final approach, set the flaps to the landing position and re-trim the airplane to a 500 fpm descent at about 80 KIAS. Do not make further adjustment to the elevator trim, and avoid excessive power adjustments. On the final approach to landing, make small power changes to control the descent. Do not reduce power suddenly at the flare-out point as this will cause an excessive nose down change and may cause the airplane to land on the nose wheel first. At the flareout point, coordinate the reduction of power with the full nose-up application of elevator trim.

TRIM TAB MALFUNCTIONS

The airplane has two axis electrically powered trim tabs. There is a trim system on/off switch located on the right side of the rocker switch panel, which turns off power to the actuators in both axes. If a runaway trim condition is encountered in flight, characterized by sudden and unexplained changes in control pressures; the trim system switch must immediately be set to the OFF position. If the pilot wishes to restore part of the system's trim, the following procedure should be used.

1. After the trim system switch has been set to OFF, the trim circuit breakers (elevator and aileron) should be pulled to the OFF position.
2. Turn the trim system switch to the ON position.
3. Based on the pressures experienced during the trim runaway, estimate which tab is least likely to have caused the runaway and which tab is most likely to have caused the runaway.
4. Set the circuit breakers least likely to have caused the runaway to the ON position. The pilot should be prepared to set the trim system switch to the OFF position in the event the diagnosis is incorrect and the faulty trim actuator is brought back on line. In most situations, the pilot should be able to easily determine which trim axis experienced the runaway condition.

WARNING

In a runaway trim emergency the two most important considerations are to (1) IMMEDIATELY turn off the trim system and (2) maintain control of the airplane. The airplane will not maintain level flight and/or proper directional control without pilot input to the affected flight control(s). If excessive control pressure is required to maintain level flight, the flight must be terminated as soon as possible. Pilot fatigue can increase significantly in this situation with the potential for making the landing more difficult.

The power to the actuator motors is supplied from the system's primary bus. In the event of a power failure, the trim tabs will not operate and the settings in place before the failure will be maintained until power is restored. Flight under these conditions or during a trim runaway condition should not impose a significant problem. Atypical control pressures will be required and the flight should be terminated as soon as possible or practicable (depending on flight conditions) to mitigate pilot fatigue. Remember that during touchdown, when power is reduced and airspeed decays, there can be substantial changes in the required control pressures.

RUDDER LIMITER FAILURE OR MALFUNCTION

General – The purpose of the rudder limiter is to restrict adverse rudder application when the airplane is near the critical angle of attack with the throttle set to more than 12 inches of Hg of manifold pressure. For more information about the rudder limiter, see the Stall warning system discussion on page 7-47. A pilot must follow certain procedures if a failure or malfunction occurs. A distinction is made between the words *failure* and *malfunction*. A failure means the rudder limiter system is completely inoperative, and the components of the system do not interfere with the normal operation of the rudder. A malfunction means one or more of the system components are stuck or operating improperly.

Failure – Failure of the rudder limiter system does not present significant problems during normal flight operations. If the rudder limiter system fails in flight, the pilot must not make adverse rudder deflections or fly near the airplane's critical angle of attack, particularly at higher

power settings. A landing shall be made as soon as practicable. Since a shorted or broken wire might cause failure of the system, it is a good idea to pull the circuit breaker.

Malfunction – A malfunction of the rudder limiter system is a more serious issue, particularly if it is stuck in the engaged position. With a stuck solenoid, the **RUDR LMTR** annunciator normally will be illuminated and left rudder travel will be restricted. The first step is to verify that the rudder limiter is engaged, and the cause of the problem is a faulty annunciator light. If the problem is a faulty light, pull the rudder limiter circuit breaker, and land as soon as practicable.

If the rudder limiter is stuck in the engaged position, the pilot should first take steps to disengage the system. To do this, pull the rudder limiter circuit breaker, waiting about 30 seconds, and then reset the circuit breaker. If this does not disengage the rudder limiter, the next step is to press the test switch on the trim panel. If this action does not release the solenoid, which is holding the rudder limiter in the engaged position, then the rudder limiter circuit breaker must be pulled and a landing made as soon as possible. If recycling the system disengages the rudder limiter, then the rudder limiter circuit breaker should be pulled and a landing made as soon as practicable.

If the solenoid is stuck, the rudder will be limited to11.5º ± 0.5º of left travel. In this situation, select an airport with an adequate runway length that minimizes crosswind component. Since the airplane tends to turn into the wind during a crosswind landing, if given a choice, a crosswind from the left is more desirable. The maximum demonstrated right crosswind component with the rudder limiter engaged is 6 knots.

Total Electrical Failure – The rudder limiter is not incorporated in the standby battery bus system. During a total electrical failure, with the main battery inoperative, the rudder limiter and the stall warning indicator will not function. In this situation, the pilot must give special attention to maintenance of proper airspeeds, particularly when near the airplane's stalling speed.

FIRES

General – Fires in flight (either engine, electrical, or cabin) are inherently more critical; however, the likelihood of such an occurrence is extremely rare. The onset of an in-flight fire can, to some degree, be forestalled through diligent monitoring of the engine instruments and vigilance for suspicious odors. Fires on the ground can be mitigated through proper starting techniques, particularly when the engine is very cold.

Engine Fires – The most common engine fires occur on the ground and are usually the result of improper starting procedures. The immoderate use of the primer pump is a primary reason since this causes engine flooding. In situations of extensive primer pump use, the excess fuel drains from the intake ports and puddles on the ground. If this happens, the aircraft should be moved away from the puddle. Otherwise, the potential exists for the exhaust system to ignite the fuel puddle on the ground. Inadvertent engine flooding is likely during situations where the engine has been cold-soaked at temperatures below 25°F (-4°C) for over two hours. See cold weather operations on page 4-25.

Cabin Fire – Follow the manufacturer's instructions for use of the fire extinguisher. For more information on using the fire extinguisher see the discussion on page 7-69. Once a cabin fire is extinguished, it is important to ventilate the cabin as soon as possible. The residual smoke and toxins from the fire extinguisher must not be inhaled for extended periods. The ventilation system should be operated at full volume with the cabin fan on. Deactivating the door seals

enhances the ventilation process. If oxygen is available, put masks on and start the oxygen flow. Oxygen must only be used after it is determined that the fire is extinguished.

LIGHTNING STRIKE

In order to prevent as much damage as possible to the electrical system, components, and avionics in the event of a lightning strike, surge protection has been built into the Columbia 300's electrical system. This surge protection comes from a large MOV (metal oxide varistor) soldered in behind the circuit breaker panel. The Columbia 300 system has one MOV on the avionics bus. The MOV is located behind the circuit breaker panel and is not accessible by the pilot in flight. It is imperative that after a lightning strike, the MOV is replaced before the next flight.

CAUTION

After a lightning strike, the MOV must be replaced before the next flight.

If the aircraft is struck by lightning in flight, the MOV will have likely prevented significant damage to the electrical components. The most likely damage will be to the equipment on the extreme ends of the airplane, such as the strobe and anti-collision lights. After the lightning strike, the pilot should reset all tripped circuit breakers. If any of the circuit breakers trip off again, they should not be reset a second time. The pilot should then determine which equipment is operating properly, and adjust the flight accordingly.

ENGINE AND PROPELLER PROBLEMS

Engine Roughness – The most common cause of a rough running engine is an improper mixture setting. Adjust the mixture in reference to the power setting and altitude in use. Do not immediately go to a full rich setting since the roughness may be caused by too rich of a mixture. If adjusting the mixture does not correct the problem, reduce throttle until roughness becomes minimal, and perform a magneto check.

Check operations on the individual left and right magnetos. If the engine operates smoothly when operating on an individual magneto, adjust power as necessary and continue. However, do not operate the engine in this manner any longer than necessary. Land as soon as possible for determination and repair of the problem. If individual magneto operations do not improve performance, set the magneto switch to BOTH, and land as soon as possible for engine repairs.

CAUTION

When operating on a single magneto, the engine may quit completely if either magneto is faulty. If this happens, close the throttle to idle and set the mixture to idle cut off before resetting the magneto switch to BOTH. This will prevent a severe backfire. When the magneto switch is set to BOTH, advance mixture and throttle to appropriate settings.

High Cylinder Head Temperatures – High cylinder head temperatures are often caused by too lean of a mixture setting. Be sure the mixture is adjusted to the proper fuel flow for the power setting in use. Put the aircraft in a gentle descent to increase airspeed. If cylinder head temperatures cannot be maintained within the prescribed limits, land as soon as possible to have the problem evaluated and repaired.

High Oil Temperature – A prolonged high oil temperature indication is usually accompanied by a drop in oil pressure. If oil pressure remains normal, then the cause of the problem could be a

faulty gauge or thermobulb. If the oil pressure drops as temperature increases, put the aircraft in a gentle descent to increase airspeed. If oil temperature does not drop after increasing airspeed, reduce power and land as soon as possible.

CAUTION

If the above steps do not restore oil temperature to normal, severe damage or an engine failure can result. Reduce power to idle, and select a suitable area for a forced landing. Follow the procedures described on page 3-5, Emergency Landing Without Engine Power. The use of power must be minimized and used only to reach the desired landing area.

Low Oil Pressure – If oil pressure drops below 30 psi at normal cruise power settings without apparent reason and the oil temperature remains normal, monitor both oil pressure and temperature closely, and land as soon as possible for evaluation and repair. If a drop in oil pressure from prescribed limits is accompanied by a corresponding excessive temperature increase, engine failure should be anticipated. Reduce power and follow the procedures described on page 3-5, Emergency Landing Without Engine Power. The use of power must be minimized and used only to reach the desired landing area.

CAUTION

The engine oil annunciator is set to illuminate when the oil pressure is less than 5 psi, which provides important information for ground operations. It is not designed to indicate the onset of potential problems in flight.

Failure of Engine Driven Fuel Pump – In the event the engine driven fuel pump fails in flight or during takeoff, there is an electrically operated backup fuel pump located in the wing area. The first indication of failure of the engine driven pump is a drop in fuel pressure followed by a FUEL annunciator and a loss of engine power.

The backup pump is normally in the ARMED position for takeoff and climb and will be activated if fuel pressure drops below 5.5 psi. In the cruise and descent configurations, the pump arming is normally in the OFF position. At the first indication of engine driven pump failure (fuel pump warning annunciator, low fuel pressure, or rough engine operations), set the throttle to full open and set the backup pump switch to the ARMED position. Thereafter, it must remain in this position and a landing must be made as soon as practicable to repair the engine driven boost pump. Please see an amplified discussion on page 3-15

NOTE

When operating at high altitudes, 15000 MSL or above, it may be necessary to set the vapor suppression switch to ON in order to keep the engine driven fuel pump from cavitating. Operation of the vapor suppression may be required at lower altitudes when the ambient temperature is significantly above normal.

Propeller Surging or Wandering – If the propeller has a tendency to surge up and down or the RPM settings seem to slowly and gently vary (propeller wandering), one or more of the following conditions may exist.

1. There may be excessive leakage in the transfer bearing. The governor may not be able to get enough oil pressure, which causes a delay in propeller responsiveness. By the time the

propeller responds to earlier governor inputs, they have changed, resulting in propeller wandering.

2. Dirty oil is another cause. Contaminants in engine oil cause blockage of close tolerance passages in the governor, leading to erratic operations.
3. Excessive play in the linkage between the governor and cockpit control can lead to erratic operations.

NOTE

Propeller surging or wandering in most instances does not limit the safe continuation of the flight. However, to preclude the occurrence of more serious problems, the issue should be corrected in a timely manner, i.e., at the conclusion of the flight. If the surging or wandering is excessive, then a landing should be made as soon as practicable.

ELECTRICAL PROBLEMS

The potential for electrical problems can be forestalled somewhat by systematic monitoring of the ammeter and voltmeter gauges. The onset of most electrical problems is indicated by abnormal readings from either or both of these gauges. The ammeter, which is presented on a analog gauge, basically measures the condition of the battery while the voltmeter indicates the condition of the airplane's electrical system in a digital format.

Under Voltage – If there is an electrical demand above what can be produced by the alternator, the battery temporarily satisfies the increased requirement and a discharging condition exists. For example, if the alternator should fail, the battery carries the entire electrical demand of the airplane. As the battery charge is expended, the voltage to the system will read something less than the optimum 14.2 volts. At approximately 8 volts, most electrical components will cease to work or will operate erratically and unreliably. Anytime the electrical demand is greater than what can be supplied by the alternator, the battery is in a discharging state. If the discharging state is not corrected, in time, there is a decay in the voltage available to the electrical system of the airplane.

Alternator Failure – If the alternator has an internal failure, i.e., it cannot be recycled and the annunciator remains on, the alternator side of the split master switch should be set to the OFF position. A relay will disconnect it from the primary bus and prevent battery drain if the failure is associated with an internal short.

Load Shedding – If the under voltage condition cannot be cured either by recycling the alternator as described on page 3-10 or reducing the electrical load to the system, then the flight should be terminated as soon as possible or as soon as practicable depending on flight conditions. All nonessential electrical and avionics equipment must be turned off.

Over Voltage – The voltage regulator is designed to trip the alternator off-line in conditions of over voltage, i.e., greater than 16.0 volts. When this happens the annunciator panel will indicate the alternator is Out. The most likely cause is transitory spikes or surges tripped the alternator off-line in the electrical system. If the alternator is not automatically disconnected in an over voltage situation, the voltage regulator is probably faulty. In this situation, the pilot must manually turn off the alternator; otherwise, damage to the electrical and avionics equipment is likely. There is increased potential for an electrical fire in an uncorrected over voltage situation.

COMPLETE ELECTRICAL FAILURE

General – Normally, a pilot can anticipate the onset of a complete electrical failure. Items like an alternator failure and a battery discharging state usually precedes the total loss of electrical power. At the point the pilot first determines the electrical system is in an uncorrectable state of decay, appropriate planning should be initiated. The primary objective is to preclude the need for use of the standby system by turning off all nonessential electrical and avionics equipment.

In case of a total and sudden or otherwise not anticipated electrical failure, the pilot must take actions appropriate to the conditions of flight. If operating in VFR daytime conditions with a favorable en route and terminal weather prognosis, the pilot might choose to continue to the planned destination. The standby battery might only be used for communications at the terminal area. In some instances, the use of the standby battery might not be necessary.

Conversely, if operating at night, under IFR conditions, or both, the pilot might need to activate the standby battery immediately. In this situation, a landing must be made as soon as possible since reliable use of the standby battery is only assured for 30 minutes. During a total electrical failure, with the main battery inoperative, the rudder limiter and the stall warning indicator will not function. Please see discussion on page 3-18.

Items Available Using the Standby Battery – The standby battery switch is located on the second row of the circuit breaker panel. Activate the system by breaking the wire on the switch guard, raising the guard, and depressing the locking push-button switch. The standby battery system provides essential equipment for emergency operations. The equipment that is operated by the standby battery is shown in (Figure 3- 5). A discussion of the items follows the table.

ITEMS AVAILABLE USING THE STANDBY BATTERY		
HSI	GPS (GX50)	ECS Servomotor
Turn Coordinator	Nav/Comm #1 (SL30)	Altitude Encoder
Flood Bar	Flaps (and indicator)	GPS Annunciator

(Figure 3- 5)

1. The GX50 GPS and the SL30 Nav/Comm provide navigational guidance. The blind encoder is connected to the standby battery and provides altitude data for the GPS.
2. Communications are maintained through use of the No. 1 SL30 Nav/Comm Radio.
3. The standby battery powers both the HSI and turn coordinator. In the unlikely event both engine-driven vacuum pumps should fail during a total electrical failure, the pilot still has two gyroscopic references.
4. The instrument flood bar under the glare shield provides interior lighting for the flight instruments. The light bypasses the dimmer switch and will operate at full brightness when the standby battery is active.
5. Wing flaps can be used; however, the use is limited to emergency forced landings in unimproved or otherwise insufficient landing areas. The anticipated scenario is a situation in which a forced landing is necessary without electrical power, such as an in-flight electrical fire. If flaps are used at the destination airport in an emergency situation in which the standby battery has been in operation for some time, they may not work or will partially extend. Moreover, using the flaps might deplete all remaining standby battery energy.
6. The servomotor, which controls air temperature for the environmental control system, can be operated to close the airflow to the cabin in emergencies involving a cabin or engine fire.

Items Not Available Using the Standby Battery – The items listed above are the only devices connected to the standby battery. Clearly, use of the standby battery will involve an emergency situation. Since each emergency situation, to some degree, is unique, the pilot must consider the effect of losing most of the airplane's electrical equipment as it relates to the specific situation. The following list is a generalized discussion of some of the more obvious issues associated with a complete electrical loss.

1. All engine gauges will not operate, including manifold pressure and RPM indications.
2. The rudder limiter system will not operate.
3. All aural and visual annunciations will be inoperative, such as stall warning, low fuel, and the fuel selector position indicator. In addition, the fuel quantity gauges will be inoperative.
4. While the gyroscopic and static air flight instruments are not affected, the clock, timer, and outside air temperature indications will not be available.
5. All electrical equipment, except the items on the standby battery, will be inoperative. Important considerations are the loss of the transponder, pitot heat, position lights, landing lights, audio panel lighting, intercom, and lighting for the magnetic compass. In addition, the door seals will be inoperative with the attendant increase in ambient noise. Since the intercom is inoperative, crew and passenger communications are more difficult.
6. The GPS will need reprogramming (including approaches), if it was in use at the time the standby battery was activated.

NOTE

In case of a total electrical failure, the "LVAC" and "RVAC" annunciator display will be inoperative. However, the vacuum gage, which is a direct reading instrument, will provide an indication of the system's condition.

Special Issues (Standby Battery) – The standby battery has three thermal-cutouts (one for each cell pair) that will suspend operation of the standby battery should any one of the three cell pairs overheat. The cutout is designed to suspend operation of the standby battery at 92ºC (198ºF). The potential for standby battery cutoff depends primarily on the cabin's ambient temperature. In general, the standby battery will become inoperative after 30 minutes if the cabin ambient temperature is 47ºC (117ºF).

This is computed by multiplying the standby battery heat up rate by 30 minutes, or 1.5ºC (1.8ºF) x 30 minutes, which gives a temperature increase of 45º C (81ºF). Clearly, at ambient cabin temperatures below 38ºC (100ºF) it is unlikely that the standby battery will achieve an overheated condition, provided it is not operated for more than 30 minutes.

The standby battery is intended to provide 30 minutes of continuous service; however, in actual practice it has the potential to exceed this service time, and depends mostly on its age and current load placed on the battery. Pilots that use the standby battery beyond the 30-minute time period do so at their own risk. In some instances, the risk associated with extended use (more than 30 minutes) must be weighed against other risk factors attendant with turning the battery off. The table below (Figure 3-6) shows the approximate temperature increase for operating periods from 30 minutes to one hour.

STANDBY BATTERY (Operating Time Versus Temperature Increase)					
Operating Time of Standby Battery	**Temperature Increase ºC**	**Temperature Increase ºF**	**Operating Time of Standby Battery**	**Temperature Increase ºC**	**Temperature Increase ºF**
30 minutes	45.0	113.0	46 minutes	57.0	134.6
32 minutes	46.5	115.7	48 minutes	58.5	137.3
34 minutes	48.0	118.4	50 minutes	60.0	140.0
36 minutes	49.5	121.1	52 minutes	61.5	142.7
38 minutes	51.0	123.8	54 minutes	63.0	145.4
40 minutes	52.5	126.5	56 minutes	64.5	148.1
42 minutes	54.0	129.2	58 minutes	66.0	150.8
44 minutes	55.5	131.9	60 minutes	67.5	153.5

(Figure 3-6)

Pilots should bear in mind that if battery operations are suspended, the standby battery cools at approximately the same rate that it heats up, i.e., a decrease of 1.5ºC (1.8ºF) per minute. Depending on the circumstances, it might be advisable to suspend standby battery operations for a period of time. For example, turn the standby battery on for 15 minutes, and then turn if off for 15 minutes. This will extend the overall flight time without overheating the battery.

WARNING

For airplane serial numbers 40004 to 40010 that have not changed to the battery with thermal cutouts, do not permit the battery's internal temperature to exceed 100ºC (212ºF). At this core temperature, the battery will vent noxious fumes into the cabin.

STATIC AIR SOURCE BLOCKAGE

The static source for the airspeed indicator, the altimeter, the rate of climb indicator, and encoder is located on the right side of the airplane's fuselage, between the cabin door and the horizontal stabilizer. The location of the static port is in an area of relatively undisturbed air. Because of the airplane's composite construction, the static source is less susceptible to airframe longevity error inherent with aluminum airplanes.

If the normal static source is blocked, an alternate static source, which uses pressure within the cabin, can be selected. Access for the alternate static source is on the pilot's knee bolster near the left dimmer control and is labeled ALT STATIC. To access the alternate static source, rotate the static control knob clockwise until it locks in the ALT position. When the alternate static source is in use, the indications of the airspeed indicator and altimeter will vary slightly. Airspeed calibration charts are in Section 5 and begin on page 5-3. No altimeter calibrations are shown since the error is less than 50 feet.

VACUUM SYSTEM FAILURE

The airplane is equipped with two separate vacuum pumps, which supply suction for the gyroscopic attitude indicator. The second vacuum pump is provided as a redundant or backup system, since the system requires only one pump. Both pumps are connected to the suction system and operate continuously. If either vacuum pump should fail, the failure is noted on the annunciator panel with an amber light indication of **LVAC** or **RVAC,** depending on which vacuum pump failed. The gyroscopic instruments will operate normally with only one pump, and

no change is perceptible on the vacuum gauge. No action is required by the pilot to activate the backup system.

In the unlikely event that both pumps fail in flight, the electric powered turn coordinator and HSI can be utilized if a pilot inadvertently flies into the clouds. Inexperienced pilots must not attempt continued operations in the clouds with a partial panel, i.e., only the turn coordinator and the static system instruments (airspeed, altimeter, and rate of climb indicator). The best procedure to follow for inadvertent flight into clouds is to execute an immediate 180° turn. If flying with a partial panel, the following procedures should be used.

1. Note the airplane's heading indication on the magnetic compass.
2. When the digital readout on the clock passes the minute or half-minute mark, begin a one-minute, standard rate turn.
3. Verify the turn rate by holding the airplane symbol in the turn coordinator on the index mark.
4. At the end of one minute, level the airplane in the turn coordinator and check the magnetic compass to verify that a 180° turn was accomplished. Depending on the airplane's initial heading, it may take a few seconds for the magnetic compass to stabilize.
5. Use the elevator to maintain altitude.

If unable to establish visual contact with the 180° turn, it may be appropriate to descend through the clouds to VFR conditions, depending on the height of the cloud base. If possible, obtain permission for the emergency descent and perform the following procedures.

1. To minimize compass swing, establish the airplane on an east or west heading.
2. Adjust the power and other engine controls to allow a gradual descent of approximately 300 to 500 feet per minute at 120 KIAS.
3. Trim the airplane for this attitude so that there are neutral control pressures.
4. Keep the wings level by reference to the airplane symbol in the turn coordinator. Monitor the magnetic compass or HSI, if installed, to ensure maintenance of the east or west heading and, if necessary, apply gentle control pressure to adjust the heading.
5. When clear of the clouds, resume normal operations if conditions permit.

These procedures are intended to preclude unintentional entry into a spiral dive. The spiral dive, commonly referred to as a Graveyard Spiral, will occur when the airplane passes its point of lateral stability, approximately 45° of bank. At this point, continued application of nose up elevator pressure will increase the airplane's angle of bank, which increases the rate of descent and the airspeed. To recover from a spiral dive the pilot should: (1) reduce power, (2) level the wings by reference to the turn coordinator, and (3) raise and level the nose by reference to the airspeed indicator, the altimeter, and the rate of climb indicator.

SPINS

The airplane, as certified by the Federal Aviation Agency, is not approved for spins of any duration. During the flight test phase of the airplane's certification, spins and/or spin recovery techniques were not performed or demonstrated. It is not known if the airplane will recover from a spin.

WARNING

Do not attempt to spin the airplane under any circumstances. The airplane, as certified by the Federal Aviation Agency, is not approved for spins of any duration. During the flight test phase of the airplane's certification, spins were not performed. It is not known if the airplane will recover from a spin.

EMERGENCY EXIT

General – It is impossible to cover all the contingencies of an emergency situation. The pilot in command must analyze all possible alternatives and select a course of action appropriate to the situation. The discussion on the following pages is intended as a generalized overview of recommended actions and issues associated with emergency egress.

Doors – In most emergencies, the main cabin doors are used as exit points. The operation of these doors is discussed on page 7-15, and there are placards near the door handles, which explain their operation. In addition, the Passenger Briefing Card discusses the operation of the cabin doors in an emergency situation. It is important that passengers are familiar with their operation since the pilot may be incapacitated during emergency exiting operations.

Seat Belts – The seat belt should not be removed until the airplane has come to a complete stop, unless there are compelling reasons to do otherwise. At other times, such as when the airplane has come to rest in an area of treetops, leaving the belts fastened might be the best course of action. When the seat belts are removed, it is helpful if the pilot and passengers stow them in a manner that minimizes interference with airplane egress patterns.

Exiting (Cabin Door(s) Operable) – If possible, use both cabin doors as exit points. In the event of a wing fire, exit on the side away from the fire. The front seat passengers should normally exit first and then, if appropriate, render assistance to the rear seat occupants. When outside and on the wing, move to the rear of the airplane, over the trailing edge of the wing, all other things being equal. If practicable, all passengers and the pilot should have a designated congregating point. Fore example, 100 feet aft of the airplane.

Exiting (Cabin Doors Inoperable) – If the cabin doors are inoperable, there is a crash ax (hatchet) located under the pilot's seat that can be used to break out one of the cabin door windows. Please see the crash ax discussion on page 3-28.

INVERTED EXIT PROCEDURES

General – In emergencies where the airplane has come to rest in an inverted position the gullwing doors will not open sufficiently to exit the airplane. If this happens, there is a crash ax below the pilot's front seat that can be used to break either of the cabin door windows. Use the following procedure.

1. Release the seat belt. The pilot should position himself or herself in a manner that minimizes injury before releasing the seat belt.
2. Remove crash ax from its holder.
3. If the airplane is situated with one wing down and touching the ground and one wing up, break the cabin door window on the up-wing side. If the wings are about level, break the door window that offers the best access. See crash ax discussion on page 3-28.
4. Exit the airplane and/or render assistance to passengers as required.

Exterior Emergency Exit Release – There is an emergency exit door hinge release that can be activated by ground personnel in the event the pilot and passengers are incapacitated. The release strap loop is located on the bottom of the airplane near the left wing saddle inside the same compartment that contains the gascolator.

It is important for the pilot to understand the procedures for using the exterior release. In some instances, the pilot may be incapacitated but conscious and able to offer verbal instructions to ground personnel. The following procedures are applicable to exterior removal of the door by ground personnel.

1. Open the gascolator compartment by pressing the two spring buttons.
2. Move the door latching mechanism of the pilot's door to the open position.
3. Pull up sharply on the emergency strap loop door hinge release.
4. Pull on the door release handle to open the door a few inches, and then move the door latching mechanism to the locked position. This will prevent the door from closing and provide an adequate handhold for removing the door.
5. Using both hands, grasp the left and right edges of the door, near the middle, and pull it away from the fuselage.
6. Rock wing to assist in the removal of the door.

WARNING

Do not pull the emergency release strap loop to test its operation. An operational test is specified during the airplane's annual inspection. If the door release is inadvertently activated, the airplane is unsafe to fly, and an appropriately trained and certificated mechanic must rearm the system.

CRASH AX

A crash ax is located under the pilot's seat for use in the event the normal cabin and the emergency door releases cannot be used. The blade of the ax points down and is inserted in an aluminum sheath, and the unit is secured with a Velcro strip. To use the ax, open the Velcro fastener and remove the ax from its sheath.

It generally works best to strike the corner edge of the window near the doorframe. Several smart blows to the window area around the perimeter of the doorframe will remove enough pieces so that the middle portion of the window can be removed with a few heavy blows. Once the major portion of the window is removed and if time and circumstances permit, use the ax blade to smooth down the jagged edges around the doorframe. This will minimize injury when egressing the airplane through the window.

WARNING

The crash ax/hatchet is a required item for the safe operation of the airplane. It must be installed and secured in its sheath during all flight operations. Do not use the crash ax for any other purposes, such as chopping wood, since it can diminish the effectiveness of the tool.

Section 4
Normal Procedures

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Section 4
Normal Procedures

INTRODUCTION

Section 4 contains checklists for normal procedures. As mentioned in Section 3, the owner of this handbook is encouraged to copy or otherwise tabulate the following normal procedures checklists in a format that is usable under flight conditions. Plastic laminated pages printed on both sides and bound together (if more than one sheet) are preferable. The first portion of Section 4 contains various checklists appropriate for normal operations. The last portion of this section contains an amplified discussion in a narrative format.

INDICATED AIRSPEEDS FOR NORMAL OPERATIONS

The speeds tabulated below (Figure 4-1), provide a general overview for normal operations and are based on a maximum certificated gross weight of 3400 pounds. At weights less than maximum certificated gross weight, the indicated airspeeds are different. The pilot should refer to Section 5 for specific configuration data.

Takeoff	Flaps Setting	Airspeed
Normal Climb Out	UP Position	106-115 KIAS
Short Field Takeoff to 50 feet	Takeoff Position	78 KIAS
Climb To Altitude	**Flaps Setting**	**Airspeed**
Normal (Best Engine Cooling)	Up Position	106-115 KIAS
Best Rate of Climb at Sea Level	Up Position	106 KIAS
Best Rate of Climb at 10,000 Feet	Up Position	93 KIAS
Best Angle of Climb at Sea Level	Up Position	80 KIAS
Best Angle of Climb at 10,000 Feet	Up Position	84 KIAS
Approach To Landing	**Flaps Setting**	**Airspeed**
Normal Approach	Up Position	105-110 KIAS
Normal Approach	Down (Landing Position)	80-85 KIAS
Short Field Landing	Down (Landing Position)	78 KIAS
Balked Landing (Go Around)	**Flaps Setting**	**Airspeed**
Apply Maximum Power	Takeoff Position	88 KIAS
Apply Maximum Power	Landing Position	80 KIAS
Maximum Recommended Turbulent Air Penetration Speed	**Flaps Setting**	**Airspeed**
3400 lbs. (1542 kg)	Up Position	148 KIAS
2500 lbs. (1134 kg)	Up Position	127 KIAS
Maximum Demonstrated Crosswind Velocity*	**Flaps Setting**	**Airspeed**
Takeoff	Takeoff Position	23 Knots
Landing	Landing Position	23 Knots

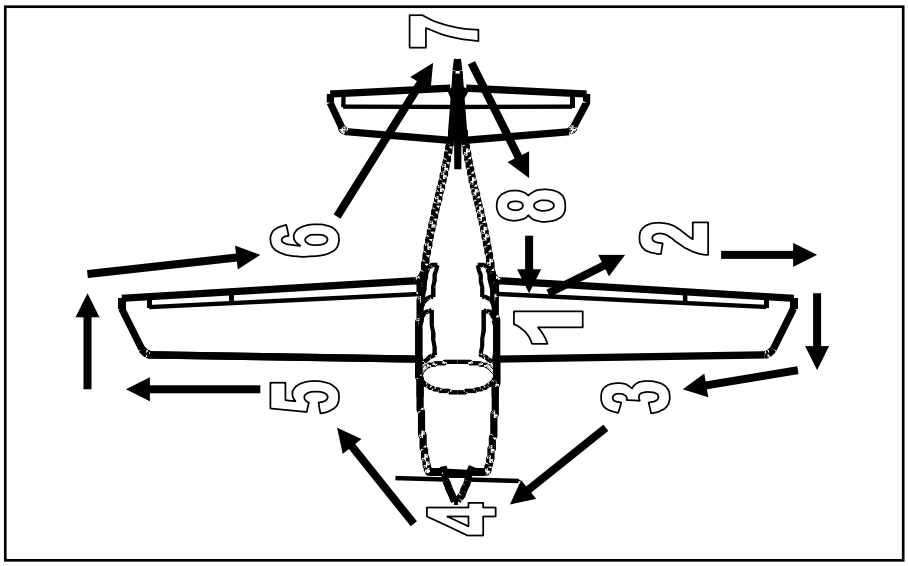
* The maximum demonstrated crosswind velocity assumes normal pilot technique and a wind with a fairly constant velocity and direction. The maximum demonstrated crosswind component of 23 knots is not considered limiting. See pages 4-10, 4-20, 4-23, and 5-6 for a discussion of techniques and a computation table.

(Figure 4-1)

NORMAL PROCEDURES CHECKLISTS

PREFLIGHT INSPECTION

Figure 4-2 depicts the major inspection points, and the arrow shows the sequence for inspecting each point. The inspection sequence in (Figure 4-2) runs in a clockwise direction; however, it does not matter in which direction the pilot performs the preflight inspection so long as it is systematic. The inspection should be initiated in the cockpit from the pilot's side of the airplane.



(Figure 4-2)

Area 1 (The Cabin)

1. Pitot Tube Cover **—** REMOVE AND STORE
2. *Pilot's Operating Handbook* — AVAILABLE IN THE AIRPLANE
3. Ignition Switch — SET TO OFF
4. Mixture **—** SET TO IDLE CUT OFF
5. Avionics Master Switch — SET TO OFF
6. Master Switch — SET TO ON (Press right side of split rocker switch.)
7. Trim System Switch — CHECK SET TO THE ON POSITION
8. Flaps — SET TO LANDING POSITION
9. Trim Tabs — SET TO NEUTRAL
10. Fuel Quantity Indicators — CHECK FUEL QUANTITY
11. Fuel Annunciators — NOT ILLUMINATED (Set fuel selector valve to left and right tanks.)
12. Rudder Limiter **—** PRESS TO TEST (See Amplified Discussion on page 4-13.)
13. Pitot Heat — ON, CHECK OPERATION (See Note and Warning that follows.)
14. Pitot Heat **—** SET TO OFF

NOTE

The heated pitot housing should be warm to the touch in a minute or so, and it should not be operated for more than one to two minutes when the airplane is in the static condition. For this reason the operational check must be performed out of sequence.

WARNING

The pitot heat can get extremely hot within one minute and care must be used when touching the housing. The technique used for testing the hotness of an iron should be employed.

Area 2 (Left Wing Flap, Trailing Edge and Wing Tip)

1. Flap — CHECK (Visually check for proper extension and security of hardware.)
2. Aileron — CHECK (Freedom of movement)
3. Left Wing Tie-down — REMOVE
4. Aileron Servo Tab — CHECK FOR PROPER OPERATION
5. Static Wicks (2) — CHECK FOR INSTALLATION AND CONDITION
6. Wing Tip — CHECK (Look for damage; check security of position and anti-collision lights.)

Area 3 (Left Wing Leading Edge, Fuel Tank, Left Tire)

1. Leading Edge — CHECK (Look for damage.)
2. Fuel Vent — CHECK FOR OBSTRUCTIONS
3. Landing Light — CHECK (Look for lens cracks and check security.)
4. Fuel Quantity — CHECK VISUALLY AND SECURE FILLER CAP
5. Wing Fuel Drain — CHECK FOR CONTAMINATION (Preceding first flight of the day or after refueling)
6. Left Main Strut and Tire — CHECK (Remove wheel chocks, check tire for proper inflation, check gear strut for evidence of damage.)
7. Main Fuel Drain — CHECK FOR CONTAMINATION (Preceding first flight of the day or after refueling)

Area 4 (Nose Section)

1. Engine Oil — CHECK LEVEL (Maintain between 6 and 8 quarts, and fill to 8 quarts for extended flights.)
2. Engine Oil Filler Cap and Accessory Door — CAP AND ACCESSORY DOOR SECURE
3. Propeller and Spinner — CHECK (Look for nicks, security, and evidence of oil leakage.)
4. Nose Wheel Strut — CHECK INFLATION (Approximately 3 to 4 inch of chrome strut must be visible.)
5. Nose Tire — CHECK (Remove wheel chocks, check tire for proper inflation.)

Area 5 (Right Wing Leading Edge, Fuel Tank, Right Tire)

1. Wing Fuel Drain — CHECK FOR CONTAMINATION (Preceding first flight of the day or after refueling.)
2. Right Main Strut and Tire — CHECK (Remove wheel chocks, check tire for proper inflation, check gear strut for evidence of damage.)
3. Leading Edge — CHECK (Look for damage.)
4. Fuel Quantity — CHECK VISUALLY AND SECURE FILLER CAP
5. Fuel Vent — CHECK FOR OBSTRUCTIONS

Area 6 (Right Wing Tip, Trailing Edge, Wing Flap, and Right Fuselage Area)

1. Wing Tip — CHECK (Look for damage; check security of position and anti-collision lights.)
2. Aileron — CHECK (freedom of movement)
3. Aileron Trim Tab — CHECK FOR NEUTRAL POSITION
4. Static Wicks (2) — CHECK FOR INSTALLATION AND CONDITION
5. Right Wing Tie-down — REMOVE
6. Flap — CHECK (Visually check for proper extension and security of hardware.)
7. Static Air Vent — CHECK FOR BLOCKAGE (Vent is located on right side of fuselage between the cabin door and the horizontal stabilizer.)
8. Antennas Bottom of Fuselage — CHECK FOR SECURITY

Area 7 (Tail Section)
1. Leading Edge of Horizontal and Vertical Surfaces — CHECK (Look for damage.)
2. Antennas Vertical Stabilizer — CHECK FOR SECURITY
3. Rudder/Elevator Hardware — CHECK (General condition and security)
4. Rudder Surface — CHECK (freedom of movement)
5. Elevator Surface — CHECK (freedom of movement)
6. Elevator Trim Tab — CHECK FOR NEUTRAL POSITION
7. Static Wicks (5) — CHECK FOR INSTALLATION AND CONDITION
8. Tail Tie-down — REMOVE

Area 8 (Aft Fuselage and Cabin)
1. Baggage Door — CHECK CLOSED AND LOCKED
2. Master Switch — SET TO OFF
3. Fire Extinguisher — CHECK FOR PRESENCE, SECURITY, AND EXPIRATION DATE
4. Crash Ax/Hatchet – CHECK FOR PRESENCE AND SECURITY

BEFORE ENGINE STARTING
1. Preflight Inspection — COMPLETE
2. Fresh Air Vents — AS REQUIRED (Close fresh air vents of unoccupied seats.)
3. Seat Belts and Shoulder Harnesses — SECURE (Stow all unused seat belts.)
4. Fuel Selector Valve — SET TO LEFT OR RIGHT TANK
5. Avionics Master Switch — SET TO OFF
6. Auto Pilot — SET TO OFF
7. Brakes — TESTED AND SET
8. All Circuit Breakers — CHECK IN
9. Standby Battery — OFF AND SAFETY WIRED

CAUTION

There is a significant amount of electric current required to start the engine. For this reason, the avionics master switch must be set to the OFF position during starting to prevent possible serious damage to the avionics equipment.

STARTING COLD ENGINE
1. Mixture Control — RICH
2. Propeller Control — SET TO HIGH RPM
3. Vapor Suppression — SET TO OFF
4. Induction Heated Air — SET TO THE OFF POSITION
5. Throttle Control — SET TO CLOSED, THEN ADVANCE ABOUT ONE INCH
6. Master Switch — SET TO ON
7. Primer Pump — PUSH IN (About 7 seconds for a cold engine. Fuel Flow should read about 12 psi.; HOT ENGINE use vapor suppression or prime for 1-2 seconds.)
8. Throttle Control — CLOSED AND THEN OPEN ½ INCH
9. Check Propeller Area — CLEAR (Ensure people/equipment are not in the propeller area.)
10. Ignition Switch — TURN TO START POSITION

STARTING HOT ENGINE
1. Mixture Control — IDLE (AFT)
2. Propeller Control — SET TO HIGH RPM
3. Throttle Control — SET TO CLOSED
4. Induction Heated Air — SET TO THE OFF POSITION
5. Master Switch — SET TO ON

6. Vapor Suppression — SET TO ON 30 SEC
7. Throttle Control — SET TO CLOSED, THEN ADVANCE ABOUT ¼ INCH
8. Check Propeller Area — CLEAR (Ensure people/equipment are not in the propeller area.)
9. Ignition Switch — TURN TO START POSITION
10. Mixture Control — ADVANCE WHEN ENGINE STARTS

NOTE

It may be necessary to leave the vapor suppression on during starting (steps 7 – 10) and turn it off about one minute after engine start.

NOTE

If the engine is only moderately warm it may be necessary to push the primer switch for a few seconds before starting.

STARTING ENGINE WITH GROUND POWER CART

1. Master Switch — VERIFY OFF
2. Check Propeller Area — CLEAR (Ensure people/equipment are not in the propeller area.)
3. Auxiliary Power Plug — CONNECT POWER PLUG (Use a 12 volt DC source)
4. Aircraft Bus— VERIFY POWERED UP (Do not turn on the BATT or ALT Switch.)
5. Mixture Control — RICH
6. Propeller Control — SET TO HIGH RPM
7. Vapor Suppression — SET TO OFF
8. Induction Heated Air — SET TO THE OFF POSITION
9. Throttle Control — SET TO CLOSED, THEN ADVANCE ABOUT ONE INCH
10. Primer Pump — PUSH IN (About 7 seconds for a cold engine. Fuel Flow should read about 12 psi.; HOT ENGINE use vapor suppression or prime for 1-2 seconds.)
11. Throttle Control — CLOSED AND THEN OPEN ½ INCH
12. Check Propeller Area — CLEAR (Ensure people/equipment are not in the propeller area.)
13. Ignition Switch — TURN TO START POSITION

CAUTION

If the engine starter is engaged for 30 seconds and the engine will not start, release the starter switch, and allow the starter motor to cool for three to five minutes. Release the starter as soon as the engine fires. Never engage the starter while the propeller is still turning.

CAUTION

The master switch should not be turned on until after the engine has started and the ground power plug has been removed.

AFTER ENGINE START WITH GROUND POWER CART

1. Throttle Control — ADJUST IDLE (900 to 1000 RPM)
2. Oil Pressure — CHECK (Ensure the red oil pressure annunciator light is off and that the oil pressure gauge reads between 30 to 60 psi.)
3. Disconnect Cart — MOTION LINE SERVICE TECHNICIAN TO DISCONNECT CART FROM PLUG
4. Master Switch — SET TO ON
5. Ammeter — CHECK (Ensure the red alternator annunciator light is off and that the ammeter is indicating the system is charging.)
6. Position and Anti-collision Lights — SET AS REQUIRED

7. Avionics Master Switch — SET TO ON
8. Radios and Required Avionics — SET AS REQUIRED
9. Before moving — CLEAR (Wait for line service technician to clear you to move.)

AFTER ENGINE START

1. Throttle Control — ADJUST IDLE (900 to 1000 RPM)
2. Oil Pressure — CHECK (Ensure the red oil pressure annunciator light is off and that the oil pressure gauge reads between 30 to 60 psi.)
3. Ammeter — CHECK (Ensure the red alternator annunciator light is off and that the ammeter is indicating the system is charging.)
4. Position and Anti-collision Lights — SET AS REQUIRED
5. Avionics Master Switch — SET TO THE ON POSITION
6. Radios and Required Avionics — SET AS REQUIRED

CAUTION

If the engine starter is engaged for 30 seconds and the engine will not start, release the starter switch and allow the starter motor to cool for three to five minutes. Release the starter as soon as the engine fires. Never engage the starter while the propeller is still turning.

BEFORE TAXI

1. Wing Flaps — SET TO UP (Cruise Position)
2. Radio Clearance — AS REQUIRED
3. Taxi Light — SET TO ON (As required)
4. HSI – SET TO THE SLAVED POSITION
5. Passenger Briefing Card — ADVISE PASSENGERS TO REVIEW
6. Brakes — RELEASE

TAXIING

1. Brakes — CHECK FOR PROPER OPERATION
2. Turn Coordinator — CHECK FOR PROPER OPERATION
3. Directional Gyro/HSI — CHECK FOR PROPER OPERATION

BEFORE TAKEOFF

1. Run Up Position — MAXIMUM HEADWIND COMPONENT
2. Parking Brake/Foot Brakes — SET or HOLD
3. Flight Controls — FREE AND CORRECT
4. Trim Tabs — SET FOR TAKEOFF
5. Flight Instruments — SET (Ensure HSI is in the slave mode.)
6. Fuel Selector Valve — SET OUT OF DETENT (Ensure that 2 seconds after the annunciator illuminates the aural warning is played.)
7. Acknowledge Switch — PRESS OFF (Ensure aural warning stops.)
8. Fuel Selector Valve — SET TO FULLER TANK
9. Autopilot Master Switch — READY POSITION (See Section 9 for preflight and functional checks. The autopilot should be in the *Ready* state but not engaged.)
10. Cabin Doors — CLOSED AND LATCHED (Verify that red annunciator door light is off.)
11. Passenger Side Door Lock — IN THE UNLOCKED POSITION
12. Engine Runup — OIL TEMPERATURE CHECK (Above 75°F)
13. Throttle — SET TO 1700 RPM, CHECK MAGNETOS (50 RPM maximum difference with a maximum drop of 150 RPM)
14. Magnetos — VERIFY SET TO BOTH

15. Propeller — CHECK OPERATION (Cycle from high to low RPM two or three times.)
16. Engine Instruments and Ammeter — CHECK (Within proper ranges)
17. Vacuum Gauge — CHECK (4.5 to 5.2 inches Hg)
18. Throttle — SET TO IDLE (Adjust friction lock as required.)
19. Radios — SET
20. Wing Flaps — TAKEOFF POSITION
21. Transponder — SET
22. Doors — LATCHED AND DETENTED
23. Annunciator Panel — ALL LIGHTS OFF
24. Door Seals — ON
25. Backup Boost Pump — ARMED
26. Time — NOTED
27. Brakes — RELEASE

WARNING

The absence of RPM drop when checking magnetos may indicate a malfunction in the ignition circuit resulting in a hot magneto, i.e., one that is not grounding properly. Should the propeller be moved by hand (as during preflight inspection) the engine might start and cause death or injury. This type of malfunction must be corrected before operating the engine.

CAUTION

Do not underestimate the importance of pre-takeoff magneto checks. When operating on single ignition, some RPM drop should always occur. Normal indications are 25 to 75 RPM and a slight engine roughness as each magneto is switched off. A drop in excess of 150 RPM may indicate a faulty magneto or fouled spark plugs.

CAUTION

If conditions are such that pitot heat may be required, turn on the pitot heat at least 5 minutes prior to takeoff.

MINOR SPARK PLUG FOULING (Minor plug fouling can usually be cleared as follows.)

1. Throttle/Brakes — HOLD BRAKES MANUALLY AND SET THROTTLE TO 2200 RPM
2. Mixture — ADJUST FOR MAXIMUM PERFORMANCE (Move towards idle cutoff until RPM peaks, and hold for 10 seconds. Return mixture to full rich.)
3. Throttle — SET TO 1700 RPM
4. Magnetos — RECHECK (50 RPM difference with a maximum drop of 150 RPM)
5. Throttle — SET TO IDLE (900 to 1000 RPM)

CAUTION

Do not operate the engine at a speed of more than 2000 RPM longer than necessary to test engine operations and observe engine instruments. Proper engine cooling depends on forward speed. Discontinue testing if temperature or pressure limits are approached.

NORMAL TAKEOFF

1. Landing/Taxi Lights — AS REQUIRED
2. Mixture — ADJUST AS REQUIRED
3. Power — SET THROTTLE CONTROL AND RPM TO FULL (2700 RPM)
4. Elevator Control — LIFT NOSE AT 70-75 KIAS
5. Climb Speed — BEST RATE OF CLIMB SPEED TO 115 KIAS
6. Wing Flaps — RETRACT (At 400 feet AGL, and at or above the best rate of climb speed)
7. Landing/Taxi Lights – OFF OR AS REQUIRED

SHORT FIELD TAKEOFF (Complete *Before Takeoff* checklist first)

1. Wing Flaps — (TAKEOFF Position)
2. Brakes — APPLY
3. Power — SET THROTTLE CONTROL TO FULL (2700 RPM)
4. Mixture — ADJUST AS REQUIRED (High altitude airport operations may require leaning.)
5. Backup Boost Pump — ARMED
6. Brakes — RELEASE
7. Elevator Control — MAINTAIN LEVEL NOSE ATTITUDE
8. Rotate Speed — 65 KIAS (5º nose up pitch attitude)
9. Climb Speed — 78 KIAS (Until clear of obstacles)
10. Wing Flaps — RETRACT (At 400 feet AGL, and at or above the best rate of climb speed)

NOTE

If usable runway length is not affected, it is preferable to use a rolling start to begin the takeoff roll as opposed to a standing start at full power. Otherwise, position the airplane to use all the runway available.

CROSSWIND OPERATIONS

Crosswind takeoffs and landings require a special technique that is incorporated into the checklist for normal takeoffs and landings and, as such, do not require a dedicated checklist. Please see the amplified discussion on pages 4-20 and 4-23 for applicable crosswind techniques.

NOTE

If the cross control method is used during a crosswind approach, the resulting slight sideslip causes the airspeed to read up to 5 kts higher or lower, depending on the direction of the sideslip.

NORMAL CLIMB

1. Airspeed — Best rate of climb to 115 KIAS (See cruise climb discussion of page 4-20)
2. Power Settings — ADJUST AS NECESSARY (See amplified discussion.)
3. Fuel Selector — SET TO RIGHT OR LEFT TANK
4. Mixture — Adjust (Adjusted for increases in altitude per AFM/POH instructions)
5. Backup Boost Pump — ARMED

MAXIMUM PERFORMANCE CLIMB

1. Airspeed — 106 to 93 KIAS (Sea level and 10,000 feet respectively)
2. Power Settings — 2700 RPM AND FULL THROTTLE
3. Fuel Selector Valve — SET TO RIGHT OR LEFT TANK (as appropriate)
4. Mixture — NEAR OR AT FULL RICH (When climbing at V_Y or V_X – see page 4-20)
5. Backup Boost Pump — ARMED

CRUISE

1. Throttle Control — SET AS APPROPRIATE (18 to 28 inches of Hg — Note: Above about 12,000, the maximum manifold pressure will be less than 18 inches of Hg)
2. Propeller Control — SET AS APPROPRIATE (2000 to 2700 RPM)
3. Mixture — LEAN AS REQUIRED (Use EGT gauge or performance charts in Section 5.)
4. Backup Boost Pump — NOT ARMED
5. Changing Fuel Tanks — PERFORM STEPS 5.1 AND 5.2.
   5.1. Fuel Selector — CHANGE AS REQUIRED (Switch tanks every 45 to 60 minutes, depending on fuel flow. The maximum permitted fuel imbalance is 10 gallons (38 L).)
   5.2. Vapor Suppression — SET TO ON DURING FUEL TANK CHANGEOVERS

NOTE

The vapor suppression must be turned on before changing the selected fuel tank. After proper engine operations are established, the pump is turned off.

When changing power the sequence control usage is important. To increase power, first increase RPM with the propeller control and then increase manifold pressure with the throttle control. To decrease power, decrease manifold pressure first with the throttle control and then decrease RPM with the propeller control.

DESCENT

1. Fuel Selector Valve — SET TO RIGHT OR LEFT (as appropriate)
2. Power Settings — AS REQUIRED
3. Mixture — MOVE TO RICHER SETTING AS REQUIRED
4. Backup Boost Pump — NOT ARMED

APPROACH

1. GPS Raim/Map Integrity — VERIFIED
2. GPS OBS/SUSP — AS REQUIRED
3. GPS CDI Button — VLOC or GPS
4. Nav aids —TUNED AND IDENTIFIED
5. Approach Course — SET
6. Altimeter — SET
7. Mixture — FULL RICH

NOTE

Passing FAF, new course may be needed.

BEFORE LANDING

1. Seat Belts and Shoulder Harnesses — SECURE (both pilot and passengers)
2. Mixture Control — SET AS REQUIRED FOR CONDITIONS
3. Fuel Selector Valve — SET TO RIGHT OR LEFT (as appropriate)
4. Backup Boost Pump — NOT ARMED
5. Propeller Control — SET TO HIGH RPM
6. Autopilot — SET TO OFF (if applicable)
7. Landing/Taxi Lights — AS REQUIRED

NORMAL LANDING

1. Approach Airspeed — AS REQUIRED FOR CONFIGURATION
   Flaps (Cruise Position) ..... 110 to 120 KIAS
   Flaps (Takeoff Position) ..... 90 to 100 KIAS
   Flaps (Landing Position) ..... 80 to 85 KIAS
2. Trim Tabs (2) — ADJUST AS REQUIRED
3. Touchdown — MAIN WHEELS FIRST
4. Landing Roll — GENTLY LOWER NOSE WHEEL
5. Braking — AS REQUIRED

SHORT FIELD LANDING (Complete Before Landing Checklist first)

1. Initial Approach Airspeed — 90 to 110 KIAS (depending on flap setting)
2. Backup Boost Pump — NOT ARMED
3. Wing Flaps — SET TO LANDING POSITION
4. Maximum Full Flap Airspeed — 119 KIAS
5. Minimum Approach Speed with Wing Flaps in Landing Position — 78 KIAS
6. Trim Tabs (2) — ADJUST AS REQUIRED
7. Power — REDUCE AT THE FLARE POINT
8. Touchdown — MAIN WHEEL FIRST
9. Landing Roll — LOWER NOSE WHEEL SMOOTHLY AND QUICKLY
10. Braking and Flaps — APPLY HEAVY BRAKING AND RETRACT FLAPS (Up position)

BALKED LANDING (Go Around)

1. Power — SET THROTTLE TO FULL (At 2700 RPM)
2. Airspeed — 80 KIAS
3. Climb — POSITIVE (Establish Positive Rate of Climb.
4. Wing Flaps — SET TO TAKEOFF POSITION
5. Wing Flaps — SET TO CRUISE AT BEST RATE OF CLIMB SPEED (more than 400 feet above the surface)
6. Backup Boost Pump — SET TO ARM

AFTER LANDING

1. Wing Flaps — SET TO UP (Cruise Position)
2. Door Seal — SET TO THE OFF POSITION
3. Transponder — SET TO STANDBY
4. Time — NOTE

SHUTDOWN

1. Parking Brake — SET
2. Throttle — SET TO IDLE (900 to 1000 RPM)
3. Autopilot — SET TO OFF
4. ELT — CHECK NOT ACTIVATED (Check before shutdown)
5. Trim Tabs (2) — SET ALL TO NEUTRAL
6. Avionics Master Switch — SET TO OFF (Ensure FlightMonitor is ready for shutdown.)
7. All Electrical Equipment — SET TO OFF (Check that all rocker switches are down.)
8. Mixture — SET TO IDLE CUT OFF
9. Ignition Switch — SET TO OFF (after engine stops)
10. Master Switch — SET TO OFF

AMPLIFIED PROCEDURES

PREFLIGHT INSPECTION

The purpose of the preflight inspection is to ascertain that the airplane is physically capable of completing the intended operation with a high degree of safety. The weather conditions, length of flight, equipment installed, and daylight conditions, to mention a few, will dictate any special considerations that should be employed.

For example, in cold weather, the pilot needs to remove even small accumulations of frost or ice from the wings and control surfaces. Additionally, the hinging and actuating mechanism of each control surface must be inspected for ice accumulation. If the flight is initiated in or will be completed at nighttime, the operation of the airplane's lighting system must be inspected. Flights at high altitude have special oxygen considerations for the pilot and passengers. Clearly, a pilot must consider numerous special issues depending on the circumstances and conditions of flight. The preflight checklist provided in this handbook covers the minimum items that must be considered. Other items must be included as appropriate, depending on the flight operations and climatic conditions.

Wing Flaps - Extending the wing flaps as part of the preflight routine permits inspection of the attachment and actuating hardware. The pilot can also roughly compare that the flaps are equally extended on each side. The flaps are not designed to serve as a step. Stepping on the flaps places unnatural loads in excess of their design and can cause damage. If the flaps are extended during the preflight inspection, it is unlikely that an uninformed passenger will use them as a step.

Aileron Servo Tab – The aileron servo tab on the trailing edge of the left aileron assists in movement of the aileron. The servo tab is connected to the aileron in a manner that causes the tab to move in a direction opposite the movement of the aileron. The increased aerodynamic force applied to the tab helps to move the aileron and reduces the level of required force to the control stick. During the preflight inspection, it should be noted that movement of the aileron, up or down, produces an opposite movement of the servo tab. When the aileron is in the neutral position, the servo tab should be neutral.

Rudder Limiter Test – There is a press to test feature for the rudder limiter located on the trim panel. This is the same switch that is used to verify operation of all LEDs associated with the trim, flaps, fuel tank position, and annunciator panel. This test of the rudder limiter is done in the cockpit during the preflight inspection. However, the test only confirms that the solenoid operates when power is applied. It does not check the logic of the system and its interface with the stall warning microswitch and the manifold pressure gauge. To verify operation of the total system, the stall warning microswitch is held in the up position for two to three seconds. The aural stall warning will be heard immediately followed by an audible "click" of the rudder limiter solenoid. See page 7-47 for more information on the stall warning system.

Fuel Drains - The inboard section of each tank contains a fuel drain near the lowest point in each tank. The fuel drain operates with a typical sampling device and can be opened intermittently for a small sample or it can be locked open to remove a large quantity of fuel. The accessory door for the gascolator/fuel strainer is located under the fuselage, on the left side, near the wing saddle. It is a conventional drain device that operates by pushing up on the valve stem. The access door in this area must be opened to access the gascolator.

During the preflight inspection, the fuel must be sampled from each drain before flying to check for the proper grade of fuel, water contamination and fuel impurities. The test must be performed

before the first flight of the day and after each refueling. If the system has water contamination, it will form as a bubble in the bottom of the collection reservoir while sediment appears as floating specks. If fuel grades are mixed, the sample will be colorless. If contamination is detected, continue to draw fuel until the samples are clear. If fuel grades were mixed, the entire fuel system may require draining. See page 8-6 for an expanded discussion of fuel contamination.

Fuel Vents – The airplane has a fuel vent for each wing tank. The vents are wedge shaped recesses built into an inspection cover. They are located under each wing approximately five feet inboard from the wing tip. The vents are installed to ensure that air pressure inside the tank is the same as the outside atmospheric pressure. The vents should be open and free of dirt, mud, and other types of clogging substances.

FUEL SELECTOR

The fuel system design does not favor the use of one fuel tank over the other. The various checklists used in this manual specify "Set to Left or Right Tank." During takeoff and landing operations, it is recommended that the fuel selector be set to the fuller tank if there are no compelling reasons to do otherwise. Under low fuel conditions, selecting the fuller tank may provide a more positive fuel flow, particularly in turbulent air. The vapor suppression must be operated while changing the selected fuel tank. However, switching the fuel tanks at low altitudes above the ground is normally not recommended unless there is a compelling reason to do otherwise.

When a tank is selected and the selector is properly seated in its detent, one of two green lights on the left and right side of the fuel gauge illuminate to indicate which tank is selected. If a green light is not illuminated, then the selector handle is not properly seated in the detent. In addition, if the fuel selector is not seated or is in the Off position, a red FUEL VALVE indication is displayed on the annunciator panel.

FUEL QUANTITY

The Columbia 300 fuel quantity measuring system described on page 7-35 provides a fairly accurate indication of the onboard fuel. The system has two sensors in each tank, and flat spots in the indicating system are minimized. Still, the gauges must never be used in place of a visual inspection of each tank. A raised metal tab is installed in the bottom of each tank, directly below the filler neck, which limits inadvertent damage to the bottom of the tank from a fuel nozzle.

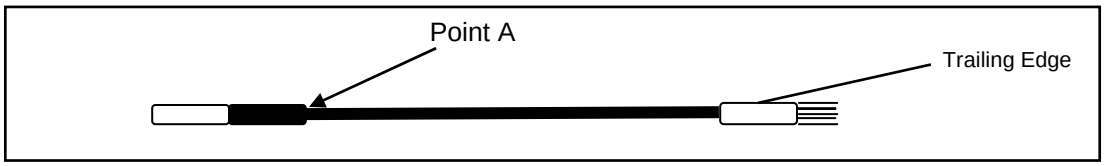
If the level of the fuel barely covers this tab, the tank contains about 25 gallons (95 L) of fuel. While this is not a certified fuel level, it does provide the pilot with an approximate indication of fuel quantity. For, example, to carry about 50 gallons (189 L) of fuel on a particular flight, each tank should be filled to the point that covers these tabs. However, since this level will vary from airplane to airplane, the best procedure is to establish the precise quantity by having empty tanks filled to the level of the tabs from a metered fuel supply. For fuel quantities above the level of the tabs, a measuring stick can be made that indicates precise quantities.

Since the tab is directly below the filler hole, it is suggested that the measuring stick be placed on these tabs when this procedure is used to determine fuel quantity. Of course, this means that it is not possible to visually sample levels less than approximately 25 gallons (95 L). However, setting sampling device in the tanks at an angle to avoid the tabs will skew indications on the stick. If such a stick is made, it must be of sufficient length to preclude being dropped into the tank.

Here are a few final suggestions regarding the measuring stick. (1) Marks on the stick should be etched into the wood or labeled with a paint that is impermeable to aviation fuel. (2) Remember, that sticking the tanks may not be a precise indication, and a margin for safety should be added. (3) It is a good idea to make a reference mark at the top of the measuring device that indicates the position of the top of the filler neck. If the reference mark on the stick goes below the tank neck when it is inserted in the tank, the measuring stick is resting on the bottom of the tank, rather than on the tab.

STATIC WICKS

The static wicks are designed to discharge accumulated static electricity created by the airplane's movement through the air. Because the Columbia 300 (LC40-550FG) cruises at higher speeds, the wicks are the solid type with a carbon interior and a plastic exterior. The static wick can be broken without obvious exterior indications. To check the wick's integrity, hold its trailing edge between the thumb and forefinger, and gently move it left and right about two inches. If the unit flexes at point A as shown in (Figure 4-3), the wick is broken and should be replaced.



(Figure 4-3)

In some instances, the owners and/or operators prefer to remove the wicks after each flight to prevent breakage during storage. If the wicks are removed, they must be reinstalled before each flight. Flight without the wicks can cause the loss of, or problems with communications and navigation. See Section 7, page 7-69 for more information.

BEFORE STARTING ENGINE

Fresh Air Vents – The fresh air eyeball vents for all unoccupied seats shall be closed when the pilot is the only person in the airplane. This is because, in the event of a fire, all ventilation must be turned off. Turning off inaccessible fresh air ventilation while attending to the demands of the emergency makes the situation more difficult.

Three Point Restraints (Seat Belts & Shoulder Harnesses) – The pilot in command is usually diligent about securing his or her restraint device; however, it is important to ensure that each passenger has their belt properly fastened. The lower body restraints on all seats are adjustable. However, they may not be similar to airline or automotive restraint devices. A passenger may have the seat belt fastened but not properly adjusted. See page 7-14 for a detailed discussion. The use of seat belts is also explained on the Passenger Briefing Card.

Stow the restraint devices on unoccupied seats to prevent fouling during emergency exiting of the airplane. Unoccupied rear seat restraints should be drawn to the smallest size possible and the male and female ends of the buckle engaged in the rear seat positions. The front seat passenger restraint buckle must not be engaged, even if the seat is unoccupied.

Child Restraints – The use of seat belts and child restraint systems (car seats) for children and infants is somewhat more complicated. The FAR's state that a child may be held by an adult who is occupying an approved seat, provided that the person being held has not reached his or her second birthday and does not occupy or use any restraining device. If a restraining device is used, the FAR's require a type approved under one of the following conditions.

1. Seats manufactured to U.S. standards between January 1, 1981, and February 25, 1985, must bear the label: "This child restraint system conforms to all applicable Federal motor vehicle safety standards."
2. Seats manufactured to U.S. standards on or after February 26, 1985, must bear two labels: "This child restraint system conforms to all applicable Federal motor vehicle safety standards" and "This restraint is certified for use in motor vehicles and aircraft" in red lettering.
3. Seats that do not meet the above requirements must bear either a label showing approval of a foreign government or a label showing that the seat was manufactured under the standards of the United Nations.

Approved child restraint systems usually limit the maximum child weight and height to 40 lbs. (18 kg) and 40 inches (102 cm), respectively. Placing higher weights in the seat exceed the intended design of child restraint system, and the only alternative is use of a passenger seat restraint. However, use of the diagonal torso restraint for a small child presents special issues since the shoulder strap may not fit across the child's shoulder and upper chest.

For a child under 55 inches (140 cm) tall, The Academy of Pediatrics (AOP) recommends the use of a lap belt, and to put the shoulder strap behind the child. This is not as protective as an adjustable lap/shoulder combination would be. In fact, use of the lap belt alone has been associated with a number of different injuries. According to the AOP, the least desirable alternative is to put the shoulder strap under one arm.

ENGINE STARTING

Normal Starting – Under normal conditions there should be no problems with starting the engine. The most common pilot mistake is over priming of the engine. The engine is primed by introducing fuel to the intake ports. The start should then be initiated immediately. As the engine starts it is important to advance the throttle slowly to maintain the proper fuel-air mixture. Abnormal atmospheric conditions require special procedures and techniques for starting the airplane. Please refer to Warm and Cold Weather Operations later in this section, which begins on page 4-25.

Under Priming – If the engine does not start in three or four revolutions of the propeller, the engine may not be adequately primed. This condition is also characterized by seemingly normal smokeless start of four or five revolutions of the propeller followed by a sudden stop, as though the mixture were in idle cut off. When the engine first starts to quit, hold the primer switch on for a few seconds until the engine runs smoothly. If this does not work, the cause of the excessively lean mixture after starting may be related to an assortment of atmospheric conditions rather than improper priming procedures. Repeat the starting procedure but allow a few extra seconds of priming.

Over Priming – If the engine starts intermittently and is followed by puffs of black smoke, over priming is the most likely cause. The black smoke means the mixture is too rich and the engine is burning off the excess fuel. The condition also occurs in hot weather where the decreased air density causes an excessive rich mixture. If this should happen, ensure that the auxiliary boost pumps are off, set the mixture to idle cut off, advance the throttle to full, and restart the engine. When the engine starts, advance the mixture to full rich and reduce the throttle setting to idle.

CAUTION

Over priming can cause a flooded intake resulting in a hydrostatic lock and subsequent engine malfunction or failure. If the engine is inadvertently or accidentally over primed, allow all the fuel to drain from the intake manifold before starting the engine.

PASSENGER BRIEFING CARD

There are a number of items with which the passengers must be familiar. These items can easily be covered through use of the Passenger Briefing Cards that are included in the airplane as part of the delivery package. It is recommended that passengers be advised of the briefing cards' location before taxiing the airplane. This will provide ample time for the passengers to review the cards before takeoff. The information contained on the briefing cards is shown below.

1. **Seat Belt** – Federal Aviation Regulations require each passenger to use the installed restraint devices during taxi, takeoff, and landing. (U.S. operating rules do not apply in Canada.) Use of the three-point restraint system is accomplished by grasping the male end of the buckle, drawing the lap webbing and diagonal harness across the lower and upper torso, and inserting it into the female end of the buckle. There is a distinctive snap when the two parts are properly connected. To release the belt, press the red button on the female portion of the buckle.
2. **Seat Belt and Harness Adjustment –** Adjusting two devices in the lap-webbing loop varies the length of the lap belt. One end of the adjustment loop contains a dowel, and the other has a small strap. Draw the dowel and strap together to enlarge the lap belt size, and draw them apart to tighten the lap belt. The upper torso restraints are connected to an inertia reel and no adjustment is required.
3. **Headsets** – If there are headsets for the passenger seating positions, their use is recommended. Comfort is enhanced in terms of noise fatigue, and the use of headsets facilitates intercom communications. To use the voice-activated microphone, position the boom mike about one quarter of an inch from the mouth, and speak in a normal voice.
4. **Emergency Exit Procedures (Cabin Doors)** – In most emergencies, the cabin doors are used for exiting the airplane. The interior door handles are located near the bottom-aft portion of the cabin doors. To open a door, pull the handle away from the door and lift up until the handle is slightly past the horizontal position. There are placards on the interior doors labeled "Open" and "Closed" with direction arrows.
5. **Crash Ax/Hatchet** – A crash ax is located under the pilot's seat for use in the event the normal cabin and the emergency door releases are inoperable. To use the ax, open the Velcro fastener and remove the ax from its sheath. It generally works best to strike the edge of the window near the doorframe. Several smart blows to the window area around the perimeter of the doorframe will remove enough pieces so that the middle portion of the window can be removed with a few heavy blows. Once the major portion of the window is removed and if time and circumstances permit, use the ax blade to smooth down the jagged edges around the doorframe. This will minimize injury when exiting the airplane through the window.
6. **Oxygen System Operation** – If the airplane is equipped with an oxygen system, the pilot will notify you when use of oxygen is required. The pilot will explain use of the equipment and applicable emergency procedures.
7. **No Smoking** – There is no smoking permitted in the airplane, no ashtrays are provided for smoking, and the airplane is not certified as such. It is a violation of Federal Aviation Regulations to smoke in this airplane. (U.S. operating rules do not apply in Canada.)

CONTROL POSITIONS VERSUS WIND COMPONENT

The airplane is stable on the ground. The low wing design minimizes the tipping tendency from strong winds while taxiing. Still, the proper positioning of control surfaces during taxiing will improve ground stability in high wind conditions. The following table, (Figure 4-4), summarizes control positions that should be maintained for a given wind component.

Wind Component	Aileron Position	Elevator Position
Left Quartering Headwind	Left Wing Aileron Up (Move Aileron Control to the Left)	Neutral Hold Elevator Control in Neutral Position
Right Quartering Headwind	Right Wing Aileron Up (Move Aileron Control to the Right)	Neutral Hold Elevator Control in Neutral Position
Left Quartering Tailwind	Left Wing Aileron Down (Move Aileron Control to the Right)	Down Elevator (Move Elevator Control Forward)
Right Quartering Tailwind	Right Wing Aileron Down (Move Aileron Control to the Left)	Down Elevator (Move Elevator Control Forward)

(Figure 4-4)

TAXIING

The first thing to check during taxiing is the braking system. This should be done a few moments after the taxi roll is begun. Apply normal braking to verify that both brakes are operational. The operation of the turn coordinator and directional gyro can be checked during taxiing provided enough time has elapsed for the instruments to become stable, normally 2 to 3 minutes. Make a few small left and right S-turns, and check the instruments for proper operation.

When taxiing, minimize the use of the brakes. Since the airplane has a free castoring nose wheel, steering is accomplished with light braking. Avoid the tendency to ride the brakes by making light steering corrections as required and then allowing the feet to slide off the brakes and the heels to touch the floor. Avoid taxiing in areas of loose gravel, small rocks, etc., since it can cause abrasion and damage to the propeller. If it is necessary to taxi in these areas, maintain low propeller speeds. If taxiing from a hard surface through a small area of gravel, obtain momentum before reaching the gravel.

The aircraft should never be taxied while the doors are in the full up position. The doors may be opened 6 to 8 inches during taxi, which can be controlled by grasping the arm rest.

BEFORE TAKEOFF

Engine Temperatures – The control of engine temperatures is an important consideration when operating the airplane on the ground. The efficient aerodynamic design and closely contoured cowling around the engine maximizes cooling in flight. However, care must be used to preclude overheating during ground operations. Before starting the engine runup check, be sure the airplane is aligned for the maximum headwind component. Conversely, when the ambient temperature is low, time may be needed for temperatures to reach normal operating ranges. Do not attempt to run up the engine until the oil temperature reaches 75°F (24°C).

Engine Runup – The engine runup is performed at 1700 RPM. To check the operation of the magnetos, move the ignition switch first to the L position and note the RPM drop. Return the

switch to the BOTH position and then move the switch to the R position to check the RPM drop. Return the switch to the BOTH position. The difference between the magnetos when operated individually cannot exceed 50 RPM, and the maximum drop on either magneto cannot be greater than 150 RPM.

To check the propeller operation, move the propeller control to the low RPM position for a few seconds until a 300 to 500 RPM drop is registered on the tachometer. Return the propeller control to the high RPM position and ensure that engine speed returns to 1700 RPM. Repeat this procedure two or three times to circulate warm oil into the propeller hub.

While the engine is set to 1700 RPM, check the engine instruments to verify that all indications are within normal limits. If the flight is to be conducted under IFR conditions or during periods of darkness, the output of the alternator should be checked. This can be done by temporarily loading the electrical system. To do this, turn on the taxi and landing lights. After a few seconds, the ammeter should stabilize with a positive charge but at a slightly lower reading.

Door Seals – Normally, the door seal switch remains in the On position for the entire flight. If the system pressure drops below 12 psi, the air pump will cycle on until pressure is restored. If the pump runs continuously, it is an indication that a seal is damaged and incapable of holding pressure. In this situation, the door seal system should not be operated until repairs are made.

TAKEOFFS

Normal Takeoff – In all takeoff situations, the primary consideration is to ascertain that the engine is developing full takeoff power. This is normally checked in the initial phase of the takeoff run. The engine should operate smoothly and provide normal acceleration. The engine RPM should read 2700 RPM and the manifold pressure should be near anticipated output. At high altitudes and/or abnormally high ambient temperatures, the mixture may need adjustment to produce maximum takeoff power. This should be done just before or during the takeoff run. With the engine set to full power, lean the mixture as required to eliminate engine roughness. When the airplane is established in a normal climb and clear of the airport, adjust the mixture as required according to the instructions on page 4-21.

Avoid the tendency to ride the brakes by making light steering corrections as required and then allowing the feet to slide off the brakes and the heels to touch the floor. For normal takeoffs (not short field) on surfaces with loose gravel and the like, the rate of throttle advancement should be slightly less than normal. While this extends the length of the takeoff run somewhat, the technique permits the airplane to obtain momentum at lower RPM settings, which reduces the potential for propeller damage. Using this technique ensures that the propeller blows loose gravel and rocks aft of the propeller blade. Rapid throttle advancement is more likely to draw gravel and rocks into the propeller blade.

Short Field Takeoff – The three major items of importance in a short field takeoff are developing maximum takeoff power, maximum acceleration, and utilization of the entire runway available. Be sure the mixture is properly set for takeoff if operating from a high altitude airport. During the takeoff run, do not raise the nose wheel too soon since this will impede acceleration. Finally, use the entire runway that is available; that is, initiate the takeoff run at the furthest downwind point available. Use a rolling start if possible, provided doing so does not affect usable runway. If a rolling start is practicable, any necessary mixture adjustment should be made just before initiating the takeoff run.
The flaps are set to the takeoff position. After liftoff, maintain the best angle of climb speed (80 to 84 KIAS at sea level and 10,000 MSL, respectively) until the airplane is clear of all obstacles.

Once past all obstacles, accelerate to the best rate of climb speed (106 KIAS) and raise the flaps. If no obstacles are present, accelerate the airplane to the best rate of climb speed and raise the flaps when at a safe height above the ground.

Crosswind Takeoff – Crosswind takeoffs should be made with takeoff flaps. When the take off run is initiated, the aileron is fully deflected into the wind. As the airplane accelerates and control response becomes more positive, the aileron deflection should be reduced as necessary. Accelerate the airplane to approximately 75 knots and then quickly lift the airplane off the ground. When airborne, turn the airplane into the wind as required to maintain alignment over the runway and in the climb out corridor. Maintain the best angle of climb speed (80 KIAS) until the airplane is clear of all obstacles. Once past all obstacles, accelerate to the best rate of climb speed (106 KIAS); at or above 400 feet AGL, raise the flaps.

NORMAL AND MAXIMUM PERFORMANCE CLIMBS

Best Rate of Climb Speeds – The normal climb speed of the airplane, 106 to 115 KIAS, produces the most altitude gain in a given time period while allowing for proper engine cooling and good forward visibility. This airspeed range is above the actual best rate of climb airspeed (V_Y) of 106 KIAS at sea level to 93 KIAS at 10,000 feet. The best rate of climb airspeed is used in situations which require the most altitude gain in a given time period, such as after takeoff when an initial 2,000 feet or so height above the ground is desirable as a safety buffer. In another situation, ATC might require the fastest altitude change possible. The mixture should be well rich of peak, near best power or at full rich if high CHT indications are experienced.

Cruise Climb – Climbing at speeds above 115 KIAS is preferable, particularly when climbing to higher altitudes, i.e., those that require more than 6,000 feet of altitude change. A 500 FPM rate climb at cruise power provides better forward visibility and engine cooling. In addition, a normal leaning schedule can be employed, which lowers fuel consumption.

Best Angle of Climb Speeds – The best angle of climb airspeed (V_X) for the airplane is 80 KIAS at sea level to 84 KIAS at 10,000 feet, with flaps in the up position. The best angle of climb airspeed produces the maximum altitude change in a given distance and is used in a situation where clearance of obstructions is required. When using the best angle of climb airspeed, the rate at which the airplane approaches an obstruction is reduced, which allows more space in which to climb. For example, if a pilot is approaching the end of a canyon and must gain altitude, the appropriate V_X speed should be used. Variations in the V_X and V_Y speeds from sea level to 10,000 feet are more or less linear, assuming ISA conditions. This equates to approximately 1.3 knots/1000 feet reduction in the V_Y speed and about 0.4 knots/1000 increase in the V_X speed.

Power Settings – Use maximum continuous power until the airplane reaches a safe altitude above the ground. Ensure the propeller RPM does not exceed the red line limitation. When the airplane is a safe altitude above the ground, power should be reduced to at least 80% of BHP. When changing power the sequence control usage is important. To decrease power, decrease manifold pressure first with the throttle control and then decrease RPM with the propeller control. The traditional practice of initially squaring power settings (for example, 25" MAP and 2500 RPM) is an acceptable procedure. If operating from an airport that is significantly above sea level elevation, no adjustment to manifold pressure may be necessary.

CRUISE

Flight Planning – Several considerations are necessary in selecting a cruise airspeed, power setting, and altitude. The primary issues are time, range, and fuel consumption. High cruise

speeds shorten the time en route, but at the expense of decreased range and increased fuel consumption.

BASIC CRUISE AND CRUISE-CLIMB PERFORMANCE CHART

WARNING THIS TABLE CANNOT BE USED FOR FLIGHT PLANNING

	Altitude	2000 ft.	4000 ft.	6000 ft.	8000 ft.	10,000 ft.
60% Power	Fuel Consumption (GPH)	11.3	11.3	11.3	11.3	11.3
	Range (nm - no reserve)	1360	1375	1395	1420	1430
	True Airspeed (Knots)	157	159	161	164	165
70% Power	Fuel Consumption (GPH)	15.1	15.1	15.1	15.1	
	Range (nm - no reserve)	1095	1120	1135	1145	
	True Airspeed (Knots)	169	173	175	177	
80% Power	Fuel Consumption (GPH)	17.2	17.2	17.2	17.2	
	Range (nm - no reserve)	980	995	1050	1080	
	True Airspeed (Knots)	172	175	185	190	

(Figure 4-5)

Cruising at higher altitudes increases true airspeed and improves fuel consumption, but the time and fuel used to reach the higher cruise altitude must be considered. Clearly, numerous factors are weighed to determine what altitude, airspeed, and power settings are optimal for a particular flight. Section 5 in this manual contains detailed information to assist the pilot in the flight planning process.

In general, the airplane cruises at 60% to 80% of available power. The previous table, (Figure 4-5) is provided as a broad overview of how power settings and altitude affect true airspeed, range, and fuel consumption. The chart is based on standard temperatures for a particular altitude. This table is not intended for flight planning purposes. Refer to Section 5 for specific information.

Mixture Settings – In cruise flight and cruise climb, care is needed to ensure that engine instrument indications are maintained within normal operating ranges. After reaching the desired altitude and engine temperatures stabilize (usually within five minutes), the mixture must be adjusted. Two methods can be used to establish the optimum mixture setting.

1. **Control by Exhaust Gas Temperature (EGT) –** First, adjust the RPM and manifold pressure (MP) to the desired setting. Next, slowly move the mixture control toward the lean position while observing the EGT gauge. Note the point at which the temperature peaks or starts to drop as the mixture is leaned further. At settings between 65% and 75% power, advance the mixture control towards rich (clockwise) until the EGT is 50ºF (10ºC) richer than the peak. At cruise settings below 65%, the engine can be operated at 50ºF (10ºC) lean of peak EGT. Once the desired EGT is determined, set the movable needle on the EGT gauge to that setting.
2. **Control by Fuel Flow –** First, adjust the RPM and MP to the desired cruise setting. Next, refer to fuel flow charts in Section 5 and determine the optimum fuel flow for the cruise altitude and temperature. (Be sure to account for nonstandard temperature conditions.) Adjust the mixture setting towards the lean position until the applicable fuel flow is obtained.
3. If the power setting is above 80% of BHP, the mixture must only be adjusted if engine roughness is experienced.

CAUTION

Do not attempt to adjust the mixture by using EGT at a setting above 75% of maximum power. To prevent detonation, when increasing power, enrich mixture, advance RPM, and adjust throttle setting, in that order. When reducing power, retard throttle, then adjust RPM and mixture.

Door Seals – Normally, the door seal switch remains in the On position for the entire flight. If the system pressure drops below 12 psi, the air pump will cycle on until pressure is restored. If the pump runs continuously, it is an indication that a seal is damaged and incapable of holding pressure. In this situation, the door seal system should not be operated until repairs are made.

Inoperative Door Seal Dump Valve – If the door seal dump valve should fail, the door seal system can still be operated. However, the door seals must not be turned on until after takeoff and must be turned off before landing. This procedure ensures rapid egress from the airplane in an emergency situation. Moreover, opening the doors with the seals inflated can damage the inflatable gaskets. For more information on the door seals and dump valve refer to page 7-16.

DESCENT

The primary considerations during the descent phase of the flight are to maintain the engine temperatures within normal indications and to systematically increase mixture settings as altitude is decreased. The descent from altitude is best performed through gradual power reductions and gradual enrichment of the mixture. Avoid long descents at low manifold pressure as the engine can cool excessively and may not accelerate properly when power is reapplied.

The fuel pump switch should only be in the "armed" position for takeoff and climb. It should be off for descent and landing; during very low power operation and improper fuel system setup it may be possible that the fuel pressure will drop below the 5.5 psi limit at which time the fuel pump will come on. If this happens, the engine will flood and quit.

If power must be reduced for long periods, set the propeller to the minimum low RPM setting and adjust manifold pressure as required to maintain the desired descent. If the outside air temperature is extremely cold, it may be necessary to add drag to the airplane by lowering the flaps so that additional power is needed to maintain the descent airspeed. Do not permit the cylinder head temperature to drop below 240°F (116°C) for more than five minutes.

WARNING

During longer descents it is imperative that the pilot occasionally clear the airplane's engine by application of partial power. This helps keep the engine from over cooling and verifies that power is available. If the engine quits during a glide, there is no positive instrument indication or annunciation of this condition, and with power reduced, there is no aural indication.

APPROACH

On the downwind leg adjust power to maintain 110 KIAS to 120 KIAS with the flaps retracted. When opposite the landing point, reduce power, set the flaps to the takeoff position, and reduce speed to about 90 KIAS. On the base leg, set the flaps to the landing position, and reduce speed to 85 or 90 KIAS. Be prepared to counteract the ballooning tendency which occurs when full flaps are applied. On final approach, maintain airspeed of 80 to 85 KIAS depending on crosswind

condition and/or landing weight. Reduce the indicated airspeed to 80 knots as the touchdown point is approached.

CAUTION

At the forward CG limit, slowing below 80 KIAS prior to the flare with idle power and full flaps, will create a situation of limited elevator authority; an incomplete flare may result.

LANDINGS

Normal Landings – Landings under normal conditions are performed with the flaps set to the landing position. The landing approach speed is 80 to 85 KIAS depending on gross weight and wind conditions. The approach can be made with or without power; however, power should be reduced to idle before touchdown. The use of forward and sideslips are permitted if required to dissipate excess altitude. Remember that the slipping maneuver will increase the stall speed of the airplane, and a margin for safety should be added to the approach airspeed.

The landing attitude is slightly nose up so that the main gear touches the ground first. After touchdown, the back-pressure on the elevator should be released slowly so the nose gear gently touches the ground. Brakes should be applied gently and evenly to both pedals. Avoid skidding the tires or holding brake pressure for sustained periods.

Short Field Landings – In a short field landing, the important issues are to land just past the beginning of the runway at minimum speed. The initial approach should be made at 85 to 90 KIAS and reduced to 80 KIAS when full flaps are applied. A low-power descent, from a slightly longer than normal final approach, is preferred. It provides more time to set up and establish the proper descent path. If there is an obstacle, cross over it at 78 KIAS. Maintain a power on approach until just prior to touchdown. Do not extend the landing flare; rather, allow the airplane to land in a slight nose up attitude on the main landing gear first. Lower the nose wheel smoothly and quickly, and apply heavy braking. However, do not skid the tires. Braking response is improved if the flaps are retracted after touchdown.

Crosswind Landings – When landing in a strong crosswind, use a slightly higher than normal approach speed and avoid the use of landing flaps unless required because of runway length. If practicable, use a 85 to 90 KIAS approach speed with the flaps in the takeoff position. A power descent, from a slightly longer than normal final approach, is preferred. It provides more time to set up and establish the proper crosswind compensation. Maintain runway alignment either with a crab into the wind, a gentle forward slip (upwind wing down), or a combination of both. Touch down on the upwind main gear first by holding aileron into the wind. As the airplane decelerates, increase the aileron deflection. Apply braking as required. Raising the flaps after landing will reduce the lateral movement caused by the wind, and also improves braking.

Sideslipping the airplane will cause the airspeed to read up to 5 kts higher or lower, depending on the direction of the sideslip. This occurs because the static air source for the airplane is only on one side of the fuselage.

Balked Landing – In a balked landing or a go-around, the primary concerns are to maximize power, minimize drag, and establish a climb. Initiate a go-around by the immediate but smooth full application of power. If the flaps are in the landing position, reduce them to the takeoff positions once a positive rate of climb is established at 80 KIAS. Increase speed to 88 KIAS and

continue to accelerate to V_Y. When the airplane is a safe distance above the surface and at 106 KIAS or higher, retract the flaps to the up position and arm the backup boost pump.

STALLS

Practicing Stalls – For unaccelerated stalls (a speed decrease of one knot/second or less), the stall recovery should be initiated at the first indication of the stall or the so-called "break" that occurs while in the nose high pitch position. A drop in attitude that cannot be controlled or maintained with the elevator control normally indicates this break.

There are fairly benign stall characteristics when the airplane is loaded with a forward CG. In most cases, there is not a discernable break even though the control stick is in the full back position. In this situation, after two seconds of full aft stick application, stall recovery should be initiated. To recover from a stall, simultaneously release back-pressure and apply full power; then level the wings with the coordinated application of rudder and aileron.

Accelerated stalls can occur at higher-than-normal airspeeds due to abrupt and/or excessive control applications. These stalls may occur in steep turns, pull-ups, or other abrupt changes in flight path. Accelerated stalls usually are more severe than unaccelerated stalls and are often unexpected because they occur at higher-than-normal airspeeds. The recovery from accelerated stalls (a speed change of three to five knots/second) is essentially the same as unaccelerated stalls. The primary difference is the indicated stall speed is usually higher and the airplane's attitude may be lower than normal stalling attitudes.

Stalling speeds, of course, are controlled by flap settings, center of gravity location, gross weight, and the rate of change in angle of attack. A microswitch in the left wing, which sounds an aural warning, is actuated when the critical angle of attack is approached. Stall speed data at various configurations are detailed on page 5-5.

Rudder Limiter Duty Cycle – The rudder limiter (RL) is an integral part of the stall warning system. During stall practice, the rudder limiter is activated during all power on stalls, and extensive operation of the system can cause overheating of the RL solenoid. The solenoid has a 15% duty cycle, which means that within a given time period, the system can be engaged only 15% of the time and at rest 85% of the time for cooling. In the period of one minute this works out to nine seconds engaged and 51 seconds at rest, or approximately one power on stall per minute.

Loading and Stall Characteristics – The center of gravity location and lateral fuel imbalance affects the airplane's stall handling characteristics. It was noted above that stall characteristics are docile with a forward CG. However, as the center of gravity moves aft, the stall handling characteristics, in terms of lateral stability, will deteriorate. On the Columbia 300, it is particularly noticeable at higher power settings with flaps in the landing position. Lateral loading is also an issue, particularly with an aft CG. When the airplane as at the maximum permitted fuel imbalance of 10 gallons, stall handling characteristics are degraded.

The loading of the airplane is an important consideration since, for example, most checkouts are performed with two pilots and no baggage, which results in a forward CG and fairly benign stall characteristics. It is recommended, during the checkout and indoctrination phase for the Columbia 300 LC40-550FG, that the pilots investigate stall performance at near gross weight with a CG towards the aft limit of the envelope. This training, of course, should be under the supervision of a qualified and certificated flight instructor.

SPINS

The airplane, as certified by the FAA, is not approved for spins of any duration. During the flight test phase of the airplane's certification, spins and/or spin recovery techniques were not performed or demonstrated. It is not known if the airplane will recover from a spin

WARNING

Do not attempt to spin the airplane under any circumstances. The airplane, as certified by the Federal Aviation Agency, is not approved for spins of any duration. During the flight test phase of the airplane's certification, spins were not performed. It is not known if the airplane will recover from a spin.

COLD WEATHER OPERATIONS

Engine starting during cold weather is generally more difficult than during normal temperature conditions. These conditions, commonly referred to as "cold soaking," causes the oil to become more viscous or thicker. Cold weather also impairs the operation of the battery. The thick oil, in combination with decreased battery effectiveness, makes it more difficult for the starter to crank the engine. At low temperatures, aviation gasoline does not vaporize readily, further complicating the starting procedure.

CAUTION

Superficial application of preheat to a cold-soaked engine can cause damage to the engine since it may permit starting but will not warm the oil sufficiently for proper lubrication of the engine parts. The amount of damage will vary and may not be evident for several hours of operation. In other situations, a problem may occur during or just after takeoff when full power is applied.

The use of a preheater is required to facilitate starting during cold weather and is required when the engine has been cold soaked at temperatures of 25°F (-4°C) or below for more than two hours. Be sure to use a high volume hot air heater. Small electric heaters that are inserted into the cowling opening do not appreciably warm the oil and may result in superficial preheating.

Apply the hot air primarily to the oil sump, filter, and cooler area for 15 to 30 minutes, and turn the propeller by hand through six to eight revolutions at 5 to 10 minute intervals. Periodically feel the top of the engine, and when some warmth is noted, apply heat directly to the upper portion of the engine for five minutes to heat the fuel lines and cylinders. This will ensure proper vaporization of the fuel when the engine is started. Start the engine immediately after completing the preheating process. Since the engine is warm, use the normal starting procedures.

WARNING

To prevent the possibility of serious injury or death, <u>always</u> treat the propeller as though the ignition switch is set to the on position. Before turning the propeller by hand, use the following procedures. Verify the magnetos switch is set to off, the throttle is closed, and the mixture is set to idle cut off. It is recommended the airplane be chocked, tied down, with the pilot's cabin door open to allow easy access to the engine controls.

After starting the engine, set the idle to 1000 RPM or less until an increase in oil temperature is noted. Monitor oil pressure closely, and watch for sudden increases or decreases in oil pressure. If necessary, reduce power below 1000 RPM to maintain oil pressure below 100 psi. If the oil

pressure drops suddenly to below 30 psi, shut the engine down, and inspect the lubricating system. If no damage or leaks are noted, preheat the engine for an additional 10 to 15 minutes.

Before takeoff, when performing the runup check, it may be necessary to incrementally increase engine RPM to prevent oil pressure from exceeding 100 psi. At 1700 RPM, adjust the propeller control to the full decrease position until minimum RPM is observed. Repeat this procedure three or four times to circulate warm oil into the propeller dome. Check magnetos and other items in the normal manner. When the oil temperature has reached 100°F and oil pressure does not exceed 70 psi at 2500 RPM, the engine has warmed sufficiently to accept full rated power. During takeoff and climb, the fuel flow may be high; however, this is normal and desirable since the engine will develop more horsepower in the substandard ambient temperatures.

NOTE

In cold weather below freezing, ensure engine oil viscosity is SAE 30, 10W30, 15W50, or 20W50. In case of temporary cold weather, consideration should be given to hangaring the airplane between flights.

The pitot tube housing contains a heating element to heat the pitot tube in the event icing conditions are encountered in flight. Do not fly in conditions which may require the use of pitot heat if the temperature is below 15°F (-9°C). If conditions are such that pitot heat may be required, turn on the pitot heat at least 5 minutes prior to takeoff.

HOT WEATHER OPERATIONS

Flight operations during hot weather usually present few problems. It is unlikely that ambient temperatures at the selected cruising altitude will be high enough to cause problems. The airplane design provides good air circulation under normal flight cruise conditions. However, there are some instances where abnormally high ambient temperatures need special attention. These are:

1. Starting a hot engine
2. Ground operations under high ambient temperature conditions
3. Takeoff and initial climb out.

After a hot engine is stopped, the temperature of its various components begins to stabilize. Engine parts with good airflow will cool faster. In some areas, where conduction is high and circulation is low, certain engine parts will increase in temperature. In particular, the fuel injection components (especially the fuel injection pump) will become heat-soaked and may cause the fuel in the system to become vaporized.

During subsequent starting attempts the fuel pump will be pumping a combination of fuel and fuel vapor. Until the entire system is filled with liquid fuel, difficult starting and unstable engine operations can normally be expected. To correct this problem, set the fuel selector to either tank, close the throttle, set the mixture to idle cutoff, and operate the primer for 15 to 20 seconds. Ensure that the vapor suppression and backup boost pumps are off, and perform a normal start.

Ground operations during high ambient temperature conditions should be kept to a minimum. In situations which involve takeoff delays, or when performing the Before Takeoff Checklist, it is imperative that the airplane is pointed into the wind. During climb out, it may be necessary to climb at a slightly higher than normal airspeed. Be sure the mixture is set properly, and do not operate at maximum power for any longer than necessary. Temperatures should be closely monitored and sufficient airspeed maintained to provide cooling of the engine.

NOTE

Heat soaking is usually the highest between 30 minutes and one hour after shutdown. At some point after the first hour the unit will stabilize, though it may take as long as two or three hours (total time from shutdown) depending on wind, temperature, and the airplane's orientation (upwind or downwind) when it was parked. Restarting attempts will be most difficult in the period 30 minutes to one hour after shutdown.

NOISE ABATEMENT

Many general aviation pilots believe that noise abatement is an issue reserved for the larger transport type airplanes. While larger airplanes clearly generate a greater decibel level, the pilot operating a small single or multiengine propeller driven airplane should, within the limits of safe operations, do all that is possible to mitigate the impact of noise on the environment. In some instances, the noise levels of small airplanes operating at smaller general aviation airfields are more noticeable. This is because at larger airports with frequent large airplane activity, there is an expectation of airplane ambient noise.

The general aviation pilot can enhance the opinion of the general public by demonstrating a concern for the environment in terms of noise pollution. To this end, common sense and courteousness should be used as basic guidelines. Part 91 of the Federal Air Regulations (FAR's) permit an altitude of 1,000 feet above the highest obstacle over congested areas (U.S. operating rules do not apply in Canada). However, an altitude of 2,000, where practicable and within the limits of safety, should be used. Similarly, during the departure and approach phases of the flight, avoid prolonged flight at lower heights above the ground. At airports where there are established noise abatement procedures in the takeoff corridor, the short field takeoff procedure should be used. This is a courteous thing to do even though the noise abatement procedure might be applicable only to turbine-powered aircraft. The certificated level for the Columbia 300 (LC40-550FG) at 3400 lbs. (1542 kg) gross weight is 85.0 dB(A), which is the maximum permitted level. The FAA has made no determination that these noise levels are acceptable or unacceptable for operations at any airport.

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Section 5
Performance

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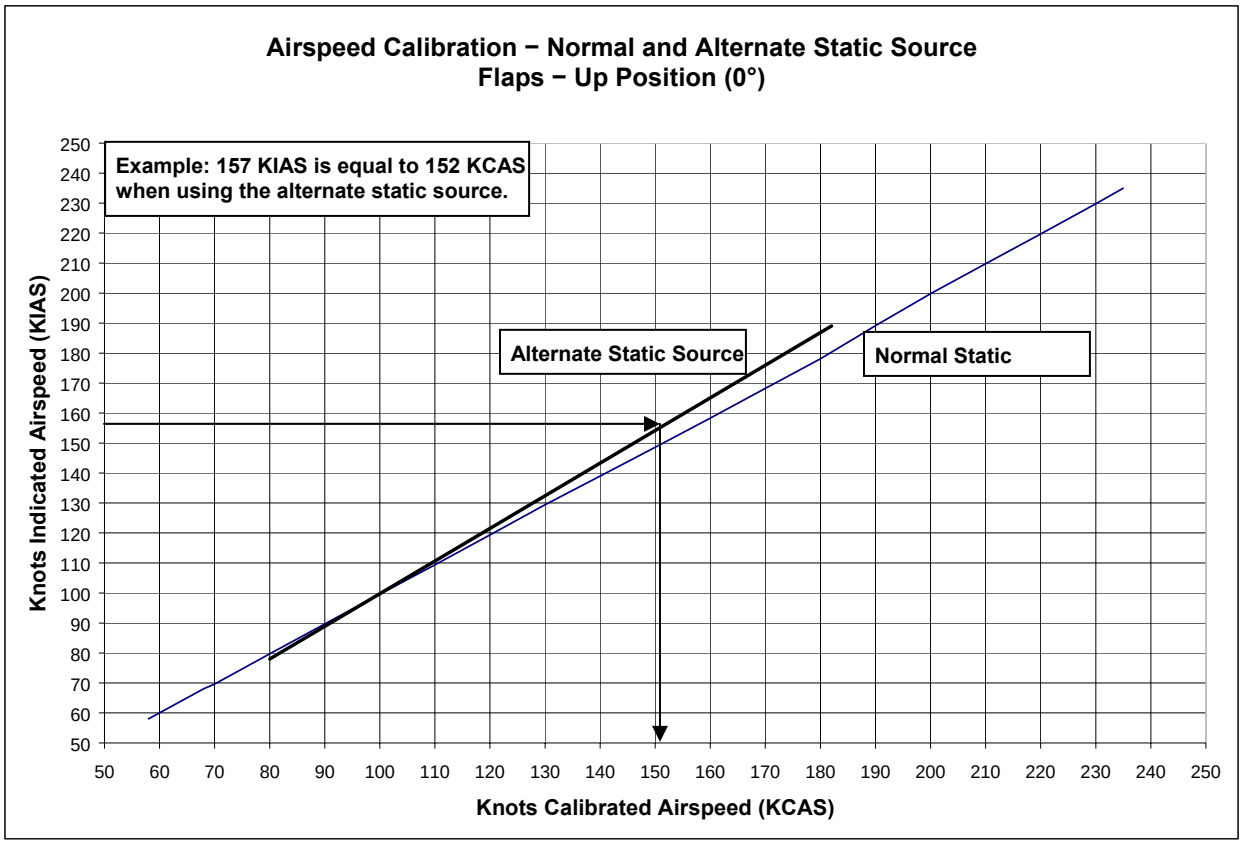
INTRODUCTION

The performance charts and graphs on the following pages are designed to assist the pilot in determining specific performance characteristics in all phases of flight operations. These phases include takeoff, climb, cruise, descent, and landing. The data in these charts were determined through actual flight tests of the airplane. At the time of the tests, the airplane and engine were in good condition and normal piloting skills were employed.

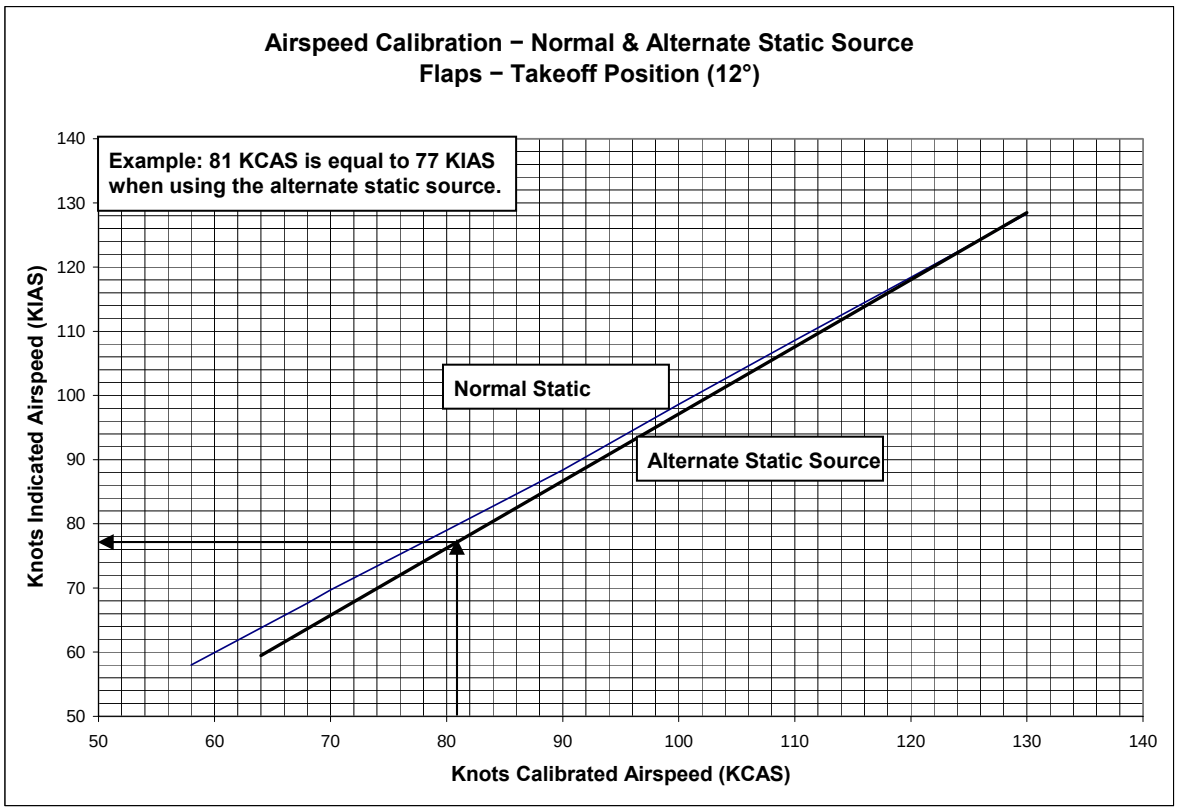
There may be slight variations between actual results and those specified in the tables and graphs. The condition of the airplane, as well as runway condition, air turbulence, and pilot techniques, will influence actual results. Fuel consumption assumes proper leaning of the mixture and control of the power settings. The combined effect of these variables may produce differences as great as 10%. The pilot must apply an appropriate margin of safety in terms of estimated fuel consumption and other performance aspects, such as takeoff and landing. Fuel endurance data include a 45-minute reserve at the specified cruise power setting. When it is appropriate, the use of a table or graph is explained or an example is shown on the graph.

When using the tables that follow, some interpolation may be required. If circumstances do not permit interpolation, then use tabulations that are more conservative. The climb and descent charts are based on sea level, and some minor subtraction is required for altitudes above sea level. For example, if 4.5 and 8.5 minutes are needed to climb from sea level to 4000 and 8000 feet respectively, then a climb from 4000 feet to 8000 feet will take about four minutes.

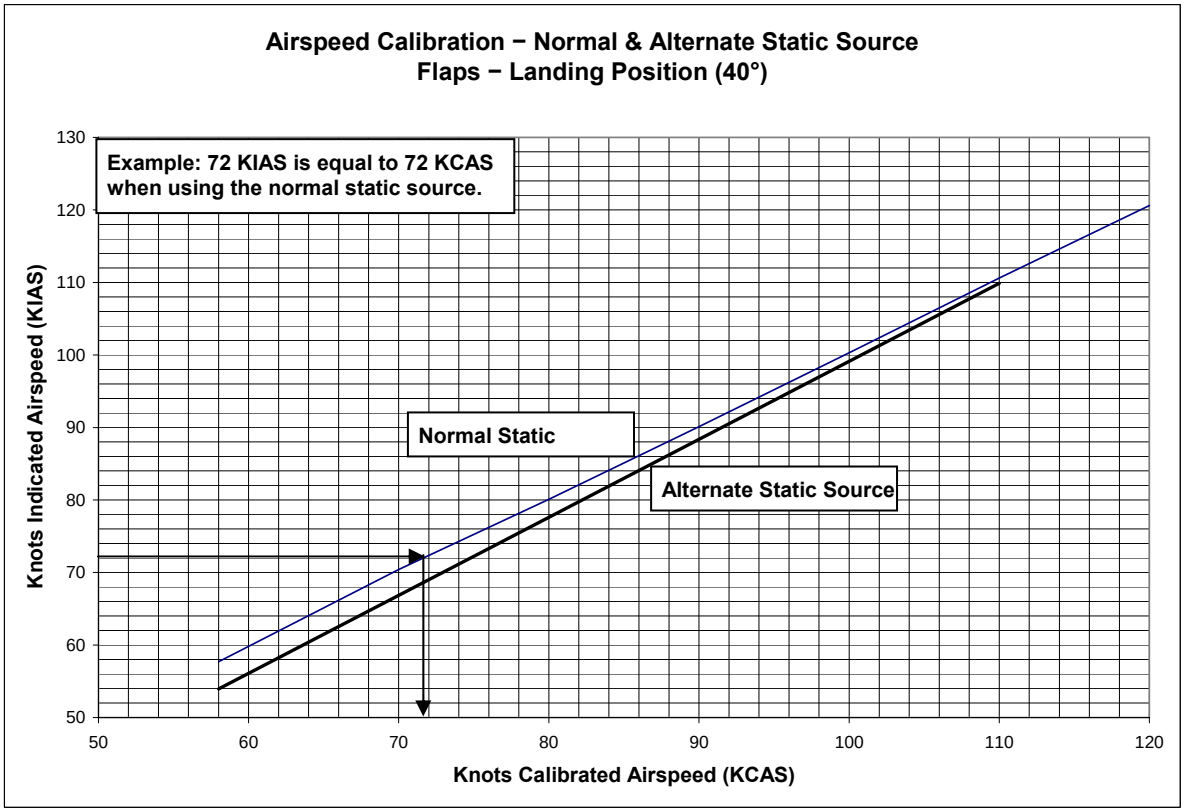
AIRSPEED CALIBRATION



(Figure 5-1)

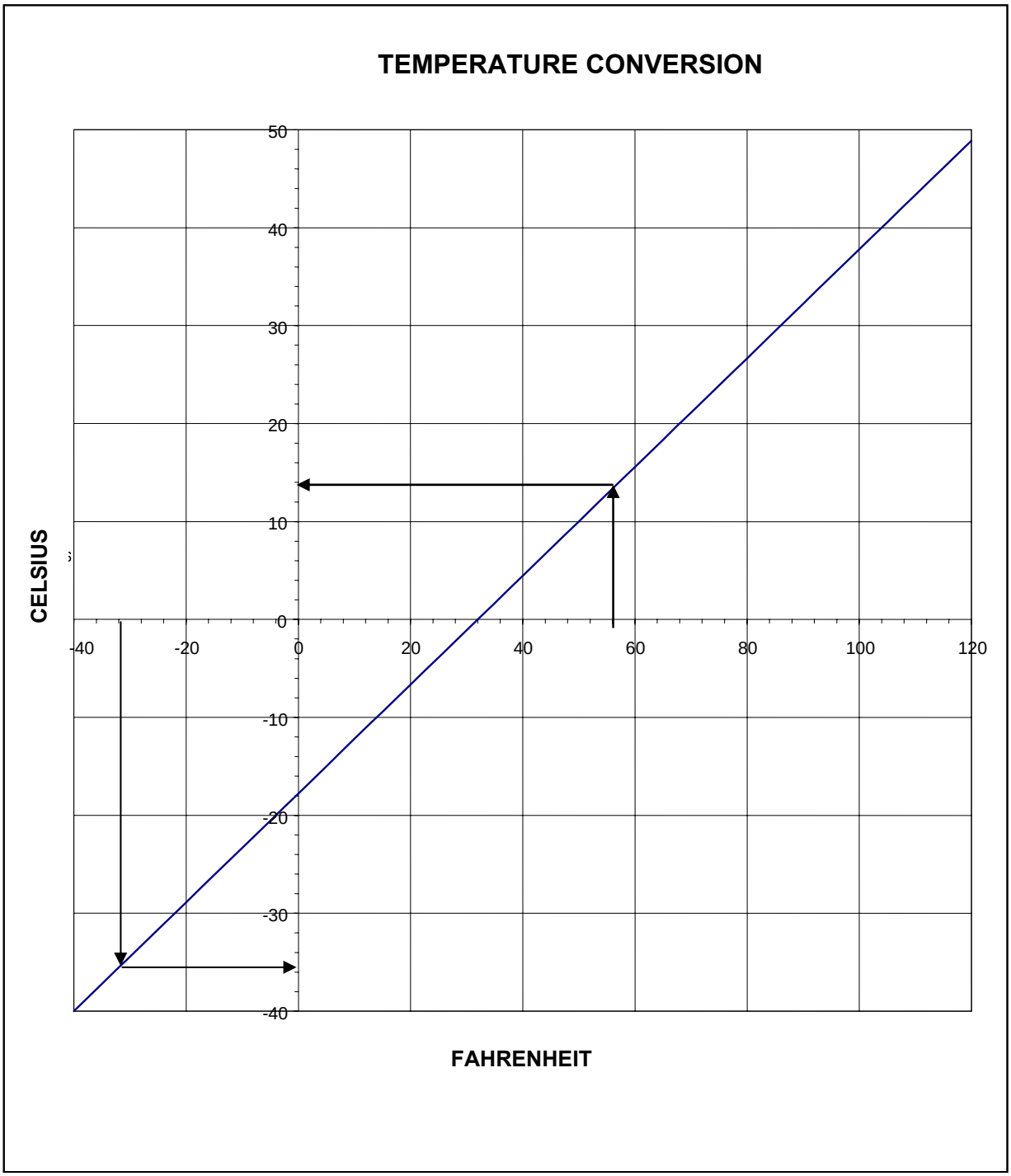


(Figure 5-2)



(Figure 5-3)

TEMPERATURE CONVERSION



(Figure 5-4)

STALL SPEEDS

The table shown in (Figure 5-5) shows the stalling speed of the airplane for various flap settings and angles of bank. To provide a factor of safety, the tabulated speeds are established using maximum gross weight and the most forward center of gravity (CG), i.e. 3400 pounds with the CG located 107 inches from the datum. This configuration will produce a higher stalling speed when compared with the speed that would result from a more rearward CG or a lesser gross weight at the same CG. While an aft CG lowers the stalling speed of the airplane, the benign

stalling characteristics attendant with a forward CG are noticeably diminished. Please see stall discussion on page 4-24. The maximum altitude loss during power off stalls is about 200 feet, Nose down attitude change during stall recovery is generally less than 5°. **Example**: Using the table below, stall speeds of 61 KIAS and 63 KCAS are indicated for 30º of bank with landing flaps.

CONDITIONS		ANGLE OF BANK (Most Forward Center of Gravity – Power Off – Coordinated Flight)							
Weight		0°		30°		45°		60°	
	Flap Setting	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
3400 lbs. (1542 kg)	Flaps - Cruise	71	71	76	76	84	84	100	100
	Flaps - Takeoff	65	65	69	69	77	78	91	93
	Flaps - Landing	57	57	61	61	68	68	80	80

(Figure 5-5)

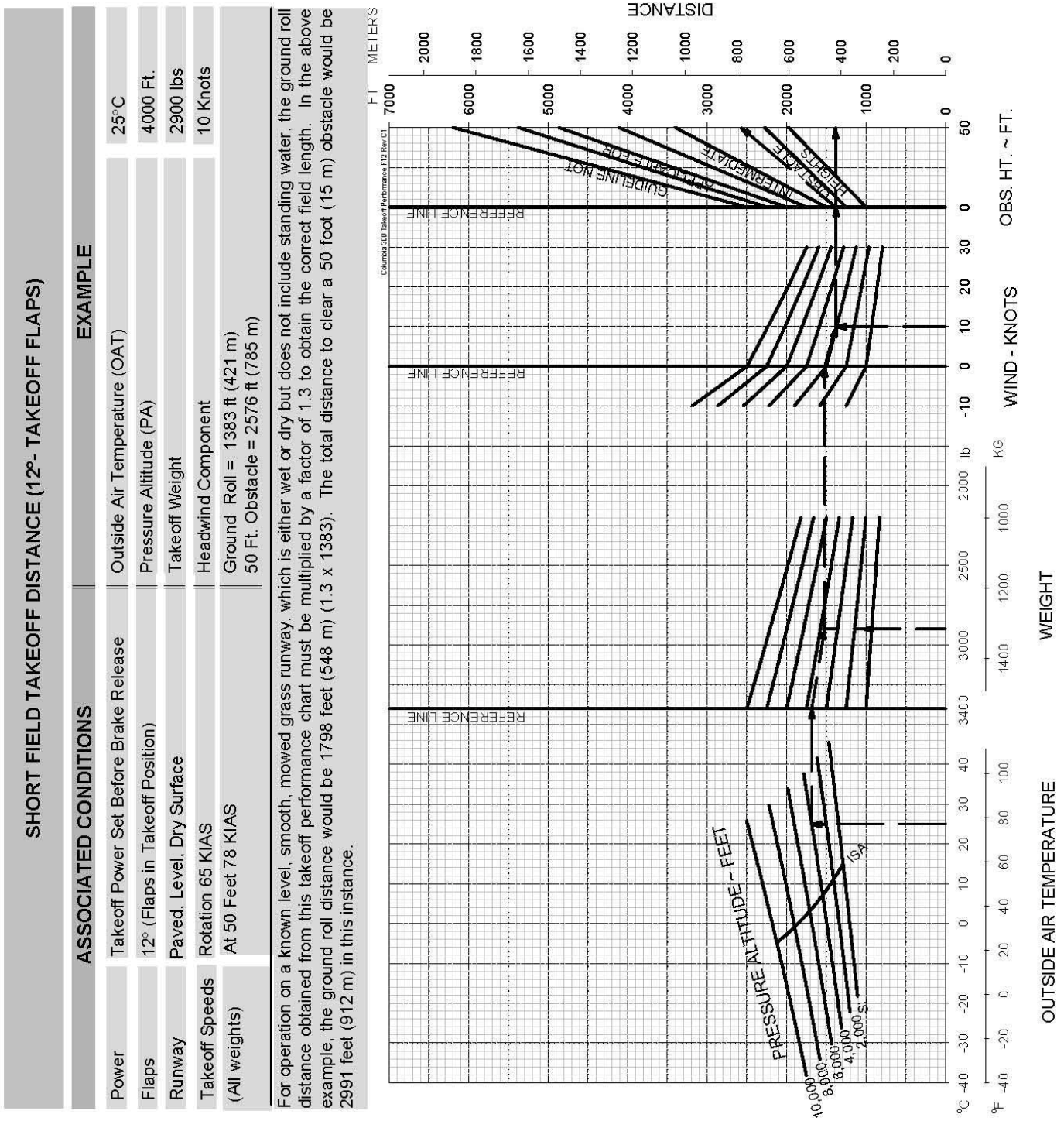
CROSSWIND, HEADWIND, AND TAILWIND COMPONENT

Degs. Wind Off Runway Centerline		10º		20º		30º		40º		50º		60º		70º		80º	
		Component in knots of		Component in knots of		Component in knots of		Component in knots of		Component in knots of		Component in knots of		Component in knots of		Component in knots of	
		Crosswind	Headwind or Tailwind	Crosswind	Headwind or Tailwind	Crosswind	Headwind or Tailwind	Crosswind	Headwind or Tailwind	Crosswind	Headwind or Tailwind	Crosswind	Headwind or Tailwind	Crosswind	Headwind or Tailwind	Crosswind	Headwind or Tailwind
WIND VELOCITY KNOTS	5	1	5	2	5	2	4	3	4	4	3	4	3	5	2	5	1
	10	2	10	3	9	5	9	6	8	8	6	9	5	9	3	10	2
	15	3	15	5	14	7	13	10	11	11	10	13	8	14	5	15	3
	20	3	20	7	19	10	17	13	15	15	13	17	10	19	7	20	3
	25	4	25	9	23	12	22	16	19	19	16	22	13	23	9	25	4
	30	5	30	10	28	15	26	19	23	23	19	26	15	28	10	30	5
	35	6	34	12	33	17	30	22	27	27	22	30	18	33	12	34	6
	40	7	39	14	38	20	35	26	31	31	26	35	20	38	14	39	7

This table is used to determine the headwind, crosswind, or tailwind component. For example, a 15-knot wind, 55° off the runway centerline, has a headwind component of 9 knots and a crosswind component of 12 knots. For tailwind components, apply the number of degrees the tailwind is off the centerline and read the tailwind component in the headwind/tailwind column. A 20-knot tailwind, 60º off the downwind runway centerline, has a tailwind component of 10 knots and a crosswind component of 17 knots.

(Figure 5-6)

SHORT FIELD TAKEOFF DISTANCE (12º - TAKEOFF FLAPS)


SHORT FIELD TAKEOFF DISTANCE (12º- TAKEOFF FLAPS)
ASSOCIATED CONDITIONS
EXAMPLE
Power
Takeoff Power Set Before Brake Release
Outside Air Temperature (OAT)
25°C
Flaps
12° (Flaps in Takeoff Position)
Pressure Altitude (PA)
4000 Ft.
Runway
Paved, Level, Dry Surface
Takeoff Weight
2900 lbs
Takeoff Speeds
Rotation 65 KIAS
Headwind Component
10 Knots
(All weights)
At 50 Feet 78 KIAS
Ground Roll = 1383 ft (421 m)
50 Ft. Obstacle = 2576 ft (785 m)
For operation on a known level, smooth, mowed grass runway, which is either wet or dry but does not include standing water, the ground roll distance obtained from this takeoff performance chart must be multiplied by a factor of 1.3 to obtain the correct field length. In the above example, the ground roll distance would be 1798 feet (548 m) (1.3 x 1383). The total distance to clear a 50 foot (15 m) obstacle would be 2991 feet (912 m) in this instance.
DISTANCE
FT
METERS
Columbia 300 Takeoff Performance F12 Rev C1
REFERENCE LINE
REFERENCE LINE
REFERENCE LINE
GUIDELINE NOT
AS TAKEOFF FOR
INTERMEDIATE
THESE ARE
PRESSURE ALTITUDE – FEET
10,000
8,000
6,000
4,000
2,000
SL
ISA
°C
°F
OUTSIDE AIR TEMPERATURE
WEIGHT
KG
lb
WIND - KNOTS
OBS. HT. ~ FT.

(Figure 5-7)

MAXIMUM RATE OF CLIMB

Weight	Pressure Altitude – Ft.	Climb Speed – KIAS	ISA - 20°C	ISA	ISA + 20°C
			Rate of Climb (Feet/Minute)		
3400 lbs. (1542 kg)	SL	106	1335	1225	1123
	2000	102	1246	1136	1034
	4000	100	1157	1047	945
	6000	97	1068	958	857
	8000	95	979	869	768
	10000	92	890	780	679
	12000	90	801	691	590
	14000	87	713	602	501
	16000	84	624	513	412
3000 lbs. (1361 kg)	SL	99	1513	1388	1273
	2000	96	1412	1287	1172
	4000	94	1311	1186	1072
	6000	91	1211	1085	971
	8000	89	1110	985	870
	10000	86	1009	884	769
	12000	85	908	788	669
	14000	82	808	682	568
	16000	79	707	581	467
2500 lbs. (1134 kg)	SL	90	1861	1666	1528
	2000	88	1695	1545	1407
	4000	86	1574	1424	1286
	6000	83	1453	1303	1165
	8000	81	1332	1182	1044
	10000	79	1211	1061	923
	12000	77	1090	940	802
	14000	75	969	819	681
	16000	72	848	698	561

Example

Weight .... 3200 lbs. (1451 kg)
Pressure Altitude 7000
Ambient Air Temp ..... 1°C

Climb Speed ..... 93 KIAS
Rate of Climb .... 975± ft/min.

Associated Conditions

Power ..... Max. continuous at 2700 RPM.
Flaps ..... Cruise
Mixture ..... At recommended leaning schedule

Notes

Fuel mixture should be leaned appropriately for altitude.

Fuel Flows

SL ..... 22.0 GPH (83.3 LPH)
2000 ..... 20.3 GPH (76.8 LPH)
4000 ..... 19.1 GPH (72.3 LPH)
6000 ..... 18.0 GPH (68.1 LPH)
8000 ..... 16.9 GPH (64.0 LPH)
10000 ..... 15.9 GPH (60.2 LPH)

(Figure 5-8)

TIME, FUEL, AND DISTANCE TO CLIMB

Pressure Altitude Feet	Climb Speed KIAS	Weight lbs. (kg)	Rate of Climb ft/min	From Sea Level		
				Time Min.†	Fuel used Gallons (Liters)	Distance – N.M.
2000	102	3400 (1542)	1136	2.5	0.9 (3.4)	3.0
		3000 (1361)	1287	2.2	0.8 (3.0)	2.6
		2500 (1134)	1545	2.0	0.8 (3.0)	2.2
4000	99	3400 (1542)	1047	4.3	1.5 (5.7)	5.2
		3000 (1361)	1186	3.9	1.4 (5.3)	5.5
		2500 (1134)	1424	3.3	1.2 (4.5)	4.6
6000	97	3400 (1542)	958	6.3	2.1 (7.9)	9.8
		3000 (1361)	1085	5.6	1.9 (7.2)	8.6
		2500 (1134)	1303	4.8	1.6 (6.1)	7.2
8000	95	3400 (1542)	869	8.5	2.7 (10.2)	13.7
		3000 (1361)	985	7.6	2.5 (9.5)	12.1
		2500 (1134)	1182	6.4	2.1 (7.9)	10.0
10000	92	3400 (1542)	780	10.9	3.4 (12.9)	18.0
		3000 (1361)	884	9.7	3.0 (11.4)	15.9
		2500 (1134)	1061	8.2	2.6 (9.8)	13.2
12000	90	3400 (1542)	691	13.6	4.1 (15.5)	22.9
		3000 (1361)	783	12.1	3.6 (13.6)	20.2
		2500 (1134)	940	10.2	3.1 (11.7)	16.8
14000	87	3400 (1542)	602	16.8	4.8 (18.2)	28.5
		3000 (1361)	682	14.9	4.3 (16.3)	25.1
		2500 (1134)	819	12.5	3.6 (13.6)	20.9
16000	84	3400 (1542)	513	20.4	5.6 (21.2)	35.0
		3000 (1361)	581	18.0	5.0 (18.9)	30.9
		2500 (1134)	698	15.2	4.2 (15.9)	35.7
18000	82	3400 (1542)	424	24.7	6.5 (24.6)	42.7
		3000 (1361)	480	21.8	5.8 (22.0)	37.7
		2500 (1134)	576	18.3	4.9 (18.5)	31.4

Example

Weight.... 3400 lbs. (1542 kg)
Cruise Press. Altitude 8500
Ambient Air Temp..... -12°C

Climb Speed**..... 94 KIAS
R of C**.....910± ft/min. (Corrected for ISA -10 deg C temp)
Time.....9.1 min
Fuel ..... 17.4 lbs. (7.9 kg)
Distance ..... 12.8 NM

Associated Conditions

Power ..... Max. Man. Press at 2700 RPM
Flaps .....Cruise
Mixture.....At recommended leaning schedule
Temp. .. Standard Day (ISA)*

*See Note 2 for approximate performance above or below ISA temperatures.

**At cruise altitude

Notes

1. Distances shown are based on zero wind.
2. For temperatures above standard, decrease the rate of climb 57 ft/min for each 10°C above the temperature.
3. For temperatures below standard, increase the rate of climb 63 ft/min for each 10°C below the temperature.

† Times include 45 seconds for takeoff and acceleration to V_Y.

(Figure 5-9)

CRUISE PERFORMANCE OVERVIEW

The tables on pages 5-11 through 5-18 contain cruise data to assist in the flight planning process. This information is tabulated for even thousand altitude increments and ranges from Sea Level feet to 16000 feet. Interpolation is required for the odd number altitudes, i.e., 5000 feet, 7000 feet, etc., as well as altitudes increments of 500 feet, such as 7500 and 9500.

The tables assume proper leaning at the various operating horsepowers. Between 65% and 75% of brake horsepower, the mixtures should be leaned through use of the exhaust gas temperature (EGT) gauge and adjusted to 50ºF rich of the peak setting. Please refer to page 4-21 in this handbook for proper leaning techniques. At brake horsepowers below 65%, the mixture may be leaned to 50ºF lean of the peak EGT setting.

The maximum recommended cruise setting is 80% of brake horsepower; however, settings of 75% and below provide better economy with only a modest sacrifice in true airspeed. The mixture must not be leaned above settings that produce more than 80% of brake horsepower unless rough engine operations are encountered. In this instance, lean the mixture slowly until smooth engine operations are reestablished. Be sure to monitor engine instruments to ensure safe ranges.

In some instances, the interpolation process will involve power settings from two different leaning schedules. For example, in (Figure 5-14) to determine the fuel flow for 2400 RPM and 22 inches of manifold pressure, temperature 26ºC (78ºF), requires interpolation between values for 2300 RPM and 2500 RPM. The brake horsepower and fuel flow at 2500 RPM are 67% BHP and 14.4 GPH (54.5 LPH). At 2300 RPM, it is 57% BHP and 10.8 GPH (40.9 LPH). Interpolating between the two sets of numbers will yield 62% BHP and 12.6 GPH (47.7 LPH). The interpolated fuel consumption, in this instance, is high because of the different leaning schedules for 57% BHP and 67% BHP. The correct answer, 11.7 GPH, is found by using the interpolated brake horsepower, 62%, and looking up the fuel consumption in (Figure 5-10). Note: By scanning the particular Cruise Performance table in use, the appropriate fuel consumption can usually be found without the need to reference (Figure 5-10).

BRAKE HORSEPOWER (BHP) AND FUEL CONSUMPTION

Percent Brake Horsepower & Fuel Consumption

Pct. BHP	GPH	LPH	Pct. BHP	GPH	LPH	Pct. BHP	GPH	LPH	Pct. BHP	GPH	LPH
40%	7.6	28.8	51%	9.6	36.3	62%	11.7	44.3	73%	15.7	59.4
41%	7.8	29.5	52%	9.8	37.1	63%	11.9	45.0	74%	15.9	60.2
42%	7.9	29.9	53%	10.0	37.9	64%	12.1	45.8	75%	16.2	61.3
43%	8.1	30.7	54%	10.2	38.6	65%	14.0	53.0	76%	16.4	62.1
44%	8.3	31.4	55%	10.4	39.4	66%	14.2	53.7	77%	16.6	62.8
45%	8.5	32.2	56%	10.6	40.1	67%	14.4	54.5	78%	16.8	63.6
46%	8.4	31.8	57%	10.8	40.9	68%	14.6	55.3	79%	17.0	64.3
47%	8.9	33.7	58%	11.0	41.6	69%	14.9	56.4	80%	17.2	65.1
48%	9.1	34.4	59%	11.2	42.4	70%	15.1	57.2	81%	17.4	65.9
49%	9.3	35.2	60%	11.3	42.8	71%	15.3	57.9	82%	17.7	67.0
50%	9.5	36.0	61%	11.5	43.5	72%	15.5	58.7	83%	17.9	67.8

(Figure 5-10)

CRUISE PERFORMANCE SEA LEVEL PRESSURE ALTITUDE

		-18°C (33°C Below Standard)				15°C (Standard Temperature)				37°C (22°C Above Standard)			
RPM	MP	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS
2700	25	89	19.3	73.1	177	85	18.2	68.9	180	82	17.7	67.0	181
	24	85	18.3	69.3	174	80	17.2	65.1	176	77	16.6	62.8	177
2500	26	84	18.1	68.5	173	80	17.2	65.1	176	77	16.6	62.8	177
	25	80	17.2	65.1	170	76	16.4	62.1	172	73	15.7	59.4	173
	24	76	16.4	62.1	166	71	15.3	57.9	168	69	14.9	56.4	169
2300	28	80	17.2	65.1	170	76	16.4	62.1	172	73	15.7	59.4	173
	27	76	16.4	62.1	167	72	15.5	58.7	168	69	14.9	56.4	169
	26	72	15.5	58.7	163	68	14.6	55.3	164	66	14.2	53.7	165
	25	69	14.9	56.4	159	65	14.0	53.0	160	62	11.7	44.3	161
	24	65	14.0	53.0	156	61	11.5	43.5	156	59	11.2	42.4	156

3400 lbs. (1542 kg) Gross Weight — Recommended Mixture Setting

Numbers shown in bold italics are outside recommended cruise horsepower limits and are included for interpolation purposes only.

Do not attempt mixture adjustment by use of EGT indications for operations above 75% of maximum power; use the fuel flow settings shown in this chart. At cruise settings between 65% and 75% power, set the mixture to 50Fº (10ºC) rich of peak EGT. See page 4-21 for a discussion of the adjustment procedures. At cruise settings below 65% power, operations at 50ºF (10ºC) lean of peak EGT will provide the lowest fuel consumption. Data in these charts are based on this leaning schedule. Finally, do not exceed 20 inches of manifold pressure below 2200 RPM.

EXAMPLE PROBLEM AND SOLUTION

Conditions	Solution
Cruise Altitude ..... 1000 feet	% of BHP 76.5%
Temperature ..... 13°C	Fuel Consumption.....16.5 GPH (62.5 LPH)*
Manifold Pressure ..... 25 inches Hg.	True Airspeed ..... 175 Knots
RPM 2500	
Determine	
1. .....% of BHP	
2. ..... Fuel Consumption (GPH)	
3. .....True Airspeed	

(Figure 5-11)

CRUISE PERFORMANCE 2000 FEET PRESSURE ALTITUDE

		-22°C (33°C Below Standard)				11°C (Standard Temperature)				33°C (22°C Above Standard)			
RPM	MP	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS
2700	23	83	17.9	67.8	175	78	16.8	63.6	177	75	16.2	61.3	178
	22	79	17.0	64.3	172	74	15.9	60.2	174	72	15.5	58.7	174
	21	73	15.7	59.4	167	69	14.9	56.4	168	67	14.4	54.5	169
	20	69	14.9	56.4	162	65	14.0	53.0	163	62	11.7	44.3	163
	19	64	12.1	45.8	157	60	11.3	42.8	157	58	11.0	41.6	157
	18	59	11.2	42.4	151	55	10.4	39.4	150	53	10.0	37.9	149
2500	25	83	17.9	67.8	175	77	16.6	62.8	177	75	16.2	61.3	178
	24	78	16.8	*63.6*	171	74	15.9	60.2	173	71	15.3	57.9	174
	23	73	15.7	59.4	167	69	14.9	56.4	169	67	14.4	54.5	169
	22	69	14.9	56.4	162	65	14.0	53.0	163	62	11.7	44.3	163
	21	65	14.0	53.0	159	61	11.5	43.5	159	59	11.2	42.4	159
	20	60	11.3	42.8	153	57	10.8	40.9	152	55	10.4	39.4	152
2300	25	71	15.3	57.9	164	66	14.2	53.7	166	64	12.1	45.8	165
	24	67	14.4	54.5	160	63	11.9	45.0	161	60	11.3	42.8	160
	23	63	11.9	45.0	156	59	11.2	42.4	156	57	10.8	40.9	156
	22	59	11.2	42.4	151	56	10.6	40.1	151	53	10.0	37.9	149
	21	56	10.6	40.1	147	53	10.0	37.9	146	51	9.6	36.3	144
	20	52	9.8	37.1	141	49	9.3	37.1	139	47	8.9	33.7	137

3400 lbs. (1542 kg) Gross Weight — Recommended Mixture Setting

Numbers shown in bold italics are outside recommended cruise horsepower limits and are included for interpolation purposes only.

Do not attempt mixture adjustment by use of EGT indications for operations above 75% of maximum power; use the fuel flow settings shown in this chart. At cruise settings between 65% and 75% power, set the mixture to 50Fº rich of peak EGT. See page 4-21 for a discussion of the adjustment procedures. At cruise settings below 65% power, operations at 50ºF (10ºC) lean of peak EGT will provide the lowest fuel consumption. Data in these charts are based on this leaning schedule. Finally, do not exceed 20 inches of manifold pressure below 2200 RPM.

EXAMPLE PROBLEM AND SOLUTION

Conditions	Solution
Cruise Altitude ..... 2000 feet Temperature ..... 22°C Manifold Pressure .....25 inch Hg. RPM ..... 2500 Determine 1. .....% of BHP 2. ..... Fuel Consumption (GPH) 3. ..... True Airspeed	% of BHP..... 77% Fuel Consumption.....16.4 GPH (62.1 LPH) True Airspeed ..... 177 Knots* *As a rule, always round to the more conservative number when using the various performance tables in this handbook.

(Figure 5-12)

CRUISE PERFORMANCE 4000 FT PRESSURE ALTITUDE

		-26°C (33°C Below Standard)				7°C (Standard Temperature)				29°C (22°C Above Standard)			
RPM	MP	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS
2700	23	86	18.5	70.0	181	81	17.4	65.9	184	78	16.8	63.6	184
	22	81	17.4	65.9	177	77	16.6	62.8	179	74	15.9	60.2	180
	21	76	16.4	62.1	173	72	15.5	58.7	174	69	14.9	56.4	174
	20	71	15.3	57.9	167	66	14.2	53.7	168	64	12.1	45.8	168
	19	66	14.2	53.7	162	62	11.7	44.3	162	60	11.3	42.8	161
	18	61	11.5	43.5	156	57	10.8	40.9	155	55	10.4	39.4	154
2500	24	81	17.4	65.9	176	76	16.4	62.1	178	73	15.7	59.4	179
	23	76	16.4	62.1	172	71	15.3	57.9	174	69	14.9	56.4	174
	22	71	15.3	57.9	167	67	14.4	54.5	168	64	12.1	45.8	168
	21	68	14.6	55.3	164	64	12.1	45.8	164	61	11.5	45.8	164
	20	63	11.9	45.0	159	59	11.2	42.4	158	57	10.8	40.9	157
	19	59	11.2	42.4	153	55	10.4	39.4	152	53	10.0	37.9	150
2300	25	73	15.7	59.4	169	68	14.6	55.3	170	66	14.2	53.7	170
	24	69	14.9	56.4	165	65	14.0	53.0	166	62	11.7	44.3	165
	23	65	14.0	53.0	160	61	11.5	43.5	160	59	11.2	42.4	159
	22	62	11.7	44.3	156	58	11.0	41.6	156	56	10.6	40.1	155
	21	58	11.0	41.6	151	54	10.2	38.6	150	52	9.8	37.1	148
	20	54	10.2	38.6	146	51	9.6	36.3	144	49	*9.3*	35.2	141

3400 lbs. (1542 kg) Gross Weight — Recommended Mixture Setting

Numbers shown in bold italics are outside recommended cruise horsepower limits and are included for interpolation purposes only.

Do not attempt mixture adjustment by use of EGT indications for operations above 75% of maximum power; use the fuel flow settings shown in this chart. At cruise settings between 65% and 75% power, set the mixture to 50Fº rich of peak EGT. See page 4-21 for a discussion of the adjustment procedures. At cruise settings below 65% power, operations at 50ºF (10ºC) lean of peak EGT will provide the lowest fuel consumption. Data in these charts are based on this leaning schedule. Finally, do not exceed 20 inches of manifold pressure below 2200 RPM.

EXAMPLE PROBLEM AND SOLUTION

Conditions	Solution
Cruise Altitude .....4000 feet	% of BHP.....73%
Temperature .....-9°C	Fuel Consumption.....15.7 GPH (59.4 LPH)
Manifold Pressure .....24 inch Hg.	True Airspeed ..... 171 Knots
RPM 2400	
Determine	
1. ..... % of BHP	
2. ..... Fuel Consumption (GPH)	
3. .....True Airspeed	

(Figure 5-13)

CRUISE PERFORMANCE 6000 FT PRESSURE ALTITUDE

		-30°C (33°C Below Standard)				3°C (Standard Temperature)				25°C (22°C Above Standard)			
RPM	MP	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS
2700	22	84	18.1	68.5	182	79	17.0	64.3	185	76	16.4	62.1	185
	21	78	16.8	63.6	177	73	15.7	59.4	179	70	15.1	57.2	179
	20	74	15.9	60.2	173	69	14.9	56.4	174	66	14.2	53.7	174
	19	68	14.6	55.3	167	64	12.1	45.8	168	62	11.7	44.3	167
	18	63	11.9	45.0	161	60	11.3	42.8	161	57	10.8	40.9	159
	17	59	11.2	42.4	155	55	10.4	39.4	154	53	10.0	37.9	152
2500	23	78	16.8	63.6	177	74	15.9	60.2	179	71	15.3	57.9	179
	22	74	15.9	60.2	173	70	15.1	57.2	175	67	14.4	54.5	175
	21	70	15.1	57.2	169	66	14.2	53.7	169	63	11.9	45.0	169
	20	65	14.0	53.0	164	61	11.5	43.5	163	59	11.2	42.4	162
	19	61	11.5	43.5	157	57	10.8	40.9	156	55	10.4	39.4	155
	18	56	10.6	40.1	151	53	10.0	37.9	149	52	9.8	37.1	146
2300	23	67	14.4	54.5	165	62	11.7	44.3	169	60	11.3	42.8	164
	22	63	11.9	45.0	161	60	11.3	42.8	164	57	10.8	40.9	159
	21	59	11.2	42.4	156	56	10.6	40.1	158	53	10.0	37.9	152
	20	55	10.4	39.4	150	52	9.8	37.1	151	50	9.5	36.0	145
	19	52	9.8	37.1	144	49	9.3	35.2	146	47	8.9	33.7	137
	18	48	9.1	34.4	137	45	8.5	32.2	137	43	8.1	30.7	126

3400 lbs. (1542 kg) Gross Weight — Recommended Mixture Setting

Numbers shown in bold italics are outside recommended cruise horsepower limits and are included for interpolation purposes only.

Do not attempt mixture adjustment by use of EGT indications for operations above 75% of maximum power; use the fuel flow settings shown in this chart. At cruise settings between 65% and 75% power, set the mixture to 50Fº rich of peak EGT. See page 4-21 for a discussion of the adjustment procedures. At cruise settings below 65% power, operations at 50ºF (10ºC) lean of peak EGT will provide the lowest fuel consumption. Data in these charts are based on this leaning schedule. Finally, do not exceed 20 inches of manifold pressure below 2200 RPM.

EXAMPLE PROBLEM AND SOLUTION

Conditions	Solution
Cruise Altitude ..... 6000 feet Temperature ..... 25°C Manifold Pressure ..... 22 inch Hg. RPM ..... 2400 Determine 1. ..... % of BHP 2. ..... Fuel Consumption (GPH) 3. ..... True Airspeed	% of BHP ..... 62% Fuel Consumption ..... 11.7 GPH* (44.3 LPH) True Airspeed ..... 167 Knots *The exact mathematical answer is 12.6 GPH by interpolation. However, leaning at 65% to 75% of BHP is different than at settings below 65% BHP. In this instance, locate a 62% BHP setting on the performance chart to determine fuel consumption. See page 5-10 for discussion details.

(Figure 5-14)

CRUISE PERFORMANCE 8000 FT PRESSURE ALTITUDE

		-34°C (33°C Below Standard)				-1°C (Standard Temperature)				21°C (22°C Above Standard)			
RPM	MP	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS
2700	22	86	18.5	70.0	188	81	17.4	65.9	191	78	16.8	63.6	191
	21	81	17.4	65.9	183	76	16.4	62.1	184	73	15.7	59.4	185
	20	75	16.2	61.3	178	71	15.3	57.9	178	68	14.6	55.3	178
	19	71	15.3	57.9	172	66	14.2	53.7	173	64	12.1	45.8	172
	18	65	14.0	53.0	166	61	11.5	43.5	166	59	11.2	42.4	164
	17	61	11.5	43.5	160	57	10.8	40.9	159	55	10.4	39.4	157
2500	22	77	16.6	62.8	179	72	15.5	58.7	181	69	14.9	56.4	180
	21	72	15.5	58.7	173	67	14.4	54.5	174	64	12.1	45.8	173
	20	68	14.6	55.3	169	63	11.9	45.0	169	61	11.5	43.5	168
	19	63	11.9	45.0	163	59	11.2	42.4	162	57	10.8	40.9	160
	18	58	11.0	41.6	156	55	10.4	39.4	154	52	9.8	37.1	151
	17	54	10.2	38.6	149	50	9.5	36.0	145	48	9.1	34.4	141
2300	22	65	14.0	53.0	166	61	11.5	43.5	166	59	11.2	42.4	164
	21	61	11.5	43.5	160	57	10.8	40.9	159	55	10.4	39.4	157
	20	57	10.8	40.9	155	54	10.2	38.6	152	51	9.6	36.3	149
	19	53	10.0	37.9	149	50	9.5	36.0	145	48	9.1	34.4	140
	18	50	9.5	36.0	141	47	8.9	33.7	136	45	8.5	32.2	129
	17	46	8.7	32.9	133	43	8.1	30.7	124	41	7.8	29.5	115

3400 lbs. Gross Weight — Recommended Mixture Setting

Numbers shown in bold italics are outside recommended cruise horsepower limits and are included for interpolation purposes only.

Do not attempt mixture adjustment by use of EGT indications for operations above 75% of maximum power; use the fuel flow settings shown in this chart. At cruise settings between 65% and 75% power, set the mixture to 50ºF (10ºC) rich of peak EGT. See page 4-21 for a discussion of the adjustment procedures. At cruise settings below 65% power, operations at 50ºF (10ºC) lean of peak EGT will provide the lowest fuel consumption. Data in these charts are based on this leaning schedule. Finally, do not exceed 20 inches of manifold pressure below 2200 RPM.

EXAMPLE PROBLEM AND SOLUTION

Conditions	Solution
Cruise Altitude ..... 8000 feet	% of BHP 81%
Temperature ..... -1°C	Fuel Consumption.....17.4 GPH* (65.9 LPH)
Manifold Pressure..... 22 inch Hg.	True Airspeed ..... 191 Knots
RPM.....2700	
Determine	*Fuel flow shown is for best power mixture. This power setting is above the maximum recommended cruise setting of 80% and does not represent a recommended mixture setting.
1. .....% of BHP	
2. .....Fuel Consumption (GPH)	
3. .....True Airspeed	

(Figure 5-15)

CRUISE PERFORMANCE 10000 FT PRESSURE ALTITUDE

		-38°C (33°C Below Standard)				-5°C (Standard Temperature)				17°C (22°C Above Standard)			
RPM	MP	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS
2700	20	78	16.8	63.6	183	73	15.7	59.4	184	70	15.1	57.2	184
	19	75	16.2	61.3	179	70	15.1	57.2	180	67	14.4	54.5	180
	18	68	14.6	55.3	172	64	12.1	45.8	172	61	11.5	43.5	171
	17	63	11.9	45.0	166	59	11.2	42.4	164	57	10.8	40.9	162
	16	62	11.7	44.3	164	58	11.0	41.6	162	55	10.4	39.4	159
	15	53	10.0	37.9	150	50	9.5	36.0	145	48	9.1	34.4	139
2500	20	70	15.1	57.2	174	66	14.2	53.7	174	63	11.9	45.0	173
	19	65	14.0	53.0	168	61	11.5	43.5	167	58	11.0	41.6	165
	18	60	11.3	42.8	161	56	10.6	40.1	159	54	10.2	38.6	156
	17	56	10.6	40.1	155	53	10.0	37.9	151	51	9.6	36.3	147
	16	52	9.8	37.1	147	48	9.1	34.4	141	47	8.9	33.7	135
2300	20	59	11.2	42.4	160	55	10.4	39.4	157	53	10.0	37.9	154
	19	55	10.4	39.4	153	52	9.8	37.1	149	50	9.5	36.0	145
	18	52	9.8	37.1	147	48	9.1	34.4	141	47	8.9	33.7	135
	17	48	9.1	34.4	139	45	8.5	32.2	130	43	8.1	30.7	121

3400 lbs. (1542 kg) Gross Weight — Recommended Mixture Setting

Do not attempt mixture adjustment by use of EGT indications for operations above 75% of maximum power; use the fuel flow settings shown in this chart. At cruise settings between 65% and 75% power, set the mixture to 50ºF (10ºC) rich of peak EGT. See page 4-21 for a discussion of the adjustment procedures. At cruise settings below 65% power, operations at 50ºF (10ºC) lean of peak EGT will provide the lowest fuel consumption. Data in these charts are based on this leaning schedule. Finally, do not exceed 20 inches of manifold pressure below 2200 RPM.

EXAMPLE PROBLEM AND SOLUTION

Conditions	Solution
Cruise Altitude ..... 9000 feet	% of BHP 72%
Temperature .....-3°C	Fuel Consumption ..... 15.5 GPH (58.7 LPH)
Manifold Pressure ..... 20 inch Hg.	True Airspeed.....180 Knots
RPM 2700	
Determine	
1. .....% of BHP	
2. .....Fuel Consumption (GPH)	
3. ..... True Airspeed	

(Figure 5-16)

CRUISE PERFORMANCE 12000 FT PRESSURE ALTITUDE

		-42°C (33°C Below Standard)				-9°C (Standard Temperature)				13°C (22°C Above Standard)			
RPM	MP	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS
2700	19	75	16.2	61.3	183	70	15.1	57.2	183	67	14.4	54.5	183
	18	70	15.1	57.2	178	66	14.2	53.7	177	63	11.9	45.0	176
	17	66	14.2	53.7	171	61	11.5	43.5	170	59	11.2	42.4	168
	16	60	11.3	42.8	163	56	10.6	40.1	160	54	10.2	38.6	157
	15	55	10.4	39.4	155	52	9.8	37.1	150	49	9.3	35.2	145
2500	19	67	14.4	54.5	174	63	11.9	45.0	173	60	11.3	42.8	171
	18	62	11.7	44.3	167	58	11.0	41.6	164	56	10.6	40.1	161
	17	58	11.0	41.6	160	54	10.2	38.6	156	52	9.8	37.1	152
	16	54	10.2	38.6	153	51	9.6	36.3	148	49	9.3	35.2	142
	15	48	9.1	34.4	140	45	8.5	32.2	131	43	8.1	30.7	119
2300	19	57	10.8	40.9	158	53	10.0	37.9	154	51	9.6	36.3	149
	18	53	10.0	37.9	151	50	9.5	36.0	145	48	9.1	34.4	138
	17	49	9.3	35.2	143	46	8.4	32.9	134	44	8.3	31.4	124
	16	46	8.7	32.9	133	43	8.1	30.7	120	41	7.8	29.5	102

3400 lbs. (1542 kg) Gross Weight — Recommended Mixture Setting

At cruise settings between 65% and 75% power, set the mixture to 50Fº rich of peak EGT. See page 4-21 for a discussion of the adjustment procedures. At cruise settings below 65% power, operations at 50ºF (10ºC) lean of peak EGT will provide the lowest fuel consumption. Data in these charts are based on this leaning schedule. Finally, do not exceed 20 inches of manifold pressure below 2200 RPM.

EXAMPLE PROBLEM AND SOLUTION

Conditions	Solution
Cruise Altitude ..... 12000 feet	% of BHP 63%
Temperature ..... -9°C	Fuel Consumption ..... 11.9 GPH (45.0 LPH)
Manifold Pressure ..... 19 inch Hg.	True Airspeed ..... 173 Knots
RPM 2500	
Determine	
1. ..... % of BHP	
2. ..... Fuel Consumption (GPH)	
3. ..... True Airspeed	

(Figure 5-17)

CRUISE PERFORMANCE 14000 FT PRESSURE ALTITUDE

		-46°C (33°C Below Standard)				-13°C (Standard Temperature)				9°C (22°C Above Standard)			
RPM	MP	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS
2700	17	74	15.9	60.2	185	69	14.9	56.4	185	67	14.4	54.5	184
	16	62	11.7	44.3	169	58	11.0	41.6	166	56	10.6	40.1	162
	15	57	10.8	40.9	160	53	10.0	37.9	155	51	9.6	36.3	149
	14	48	9.1	34.4	141	45	8.5	32.2	129	43	8.1	30.7	114
2500	17	60	11.3	42.8	165	56	10.6	40.1	161	54	10.2	38.6	156
	16	55	10.4	39.4	155	51	9.6	36.3	149	49	9.3	35.2	142
	15	50	9.5	36.0	146	47	8.9	33.7	137	45	8.5	32.2	125

3400 lbs. (1542 kg) Gross Weight Recommended Mixture Setting

At cruise settings between 65% and 75% power, set the mixture to 50°F (10ºC) rich of peak EGT. See page 4-21 for a discussion of the adjustment procedures. At cruise settings below 65% power, operations at 50ºF (10ºC) lean of peak EGT will provide the lowest fuel consumption. Data in these charts are based on this leaning schedule. Finally, do not exceed 20 inches of manifold pressure below 2200 RPM.

(Figure 5-18)

CRUISE PERFORMANCE 16000 FT PRESSURE ALTITUDE

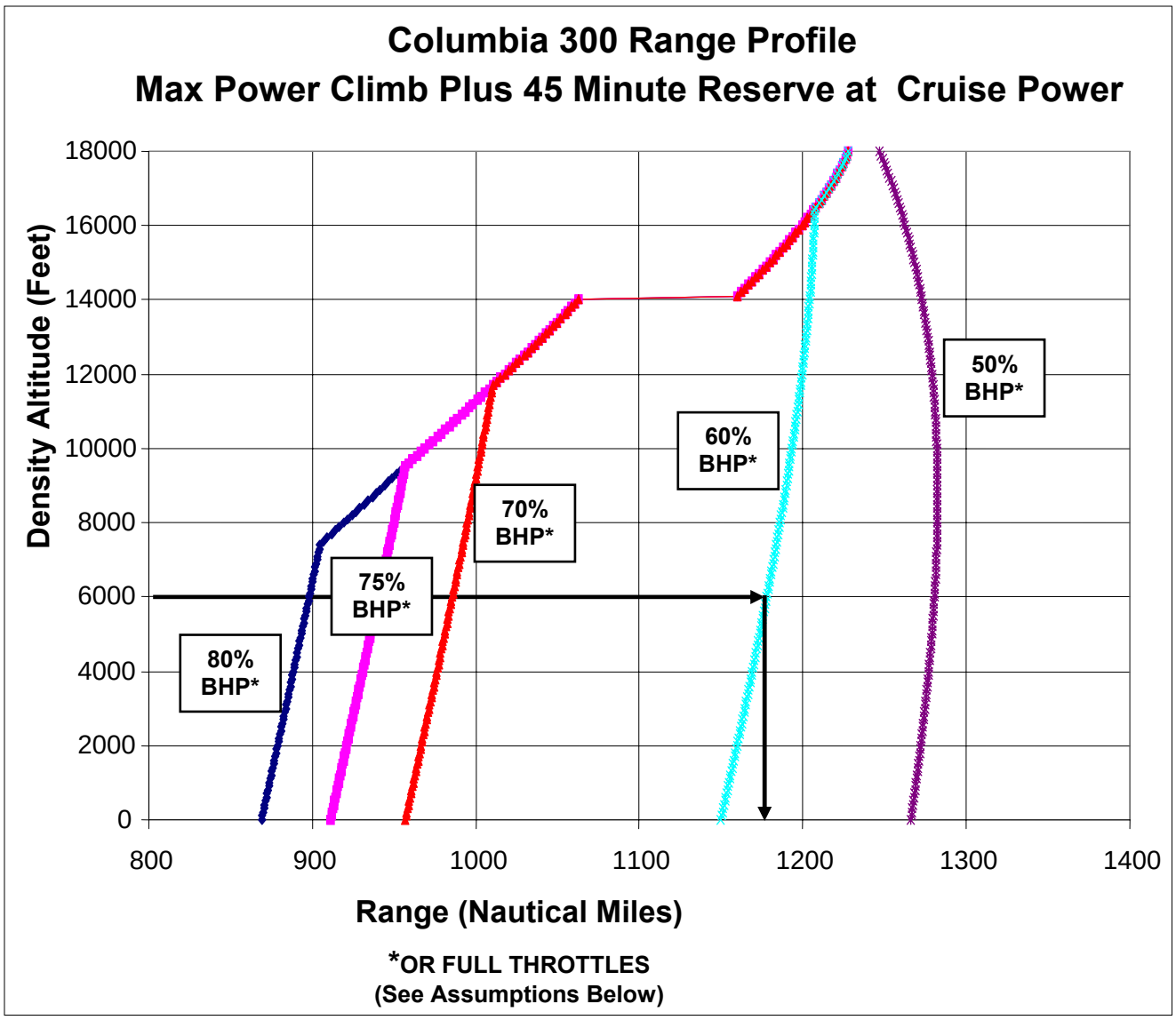
		-50°C (33°C Below Standard)				-17°C (Standard Temperature)				5°C (22°C Above Standard)			
RPM	MP	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS	% BHP	GPH	LPH	KTAS
2700	16	64	12.1	45.8	175	60	11.3	42.8	171	58	11.0	41.6	167
	15	56	10.6	40.1	159	52	9.8	37.1	152	50	9.5	36.0	143
2500	16	56	10.6	40.1	160	53	10.0	37.9	154	50	9.5	36.0	146

3400 lbs. (1542 kg) Gross Weight Recommended Mixture Setting

At cruise settings between 65% and 75% power, set the mixture to 50°Fº (10ºC) rich of peak EGT. See page 4-21 for a discussion of the adjustment procedures. At cruise settings below 65% power, operations at 50ºF (10ºC) lean of peak EGT will provide the lowest fuel consumption. Data in these charts are based on this leaning schedule. Finally, do not exceed 20 inches of manifold pressure below 2200 RPM.

(Figure 5-19)

RANGE PROFILE

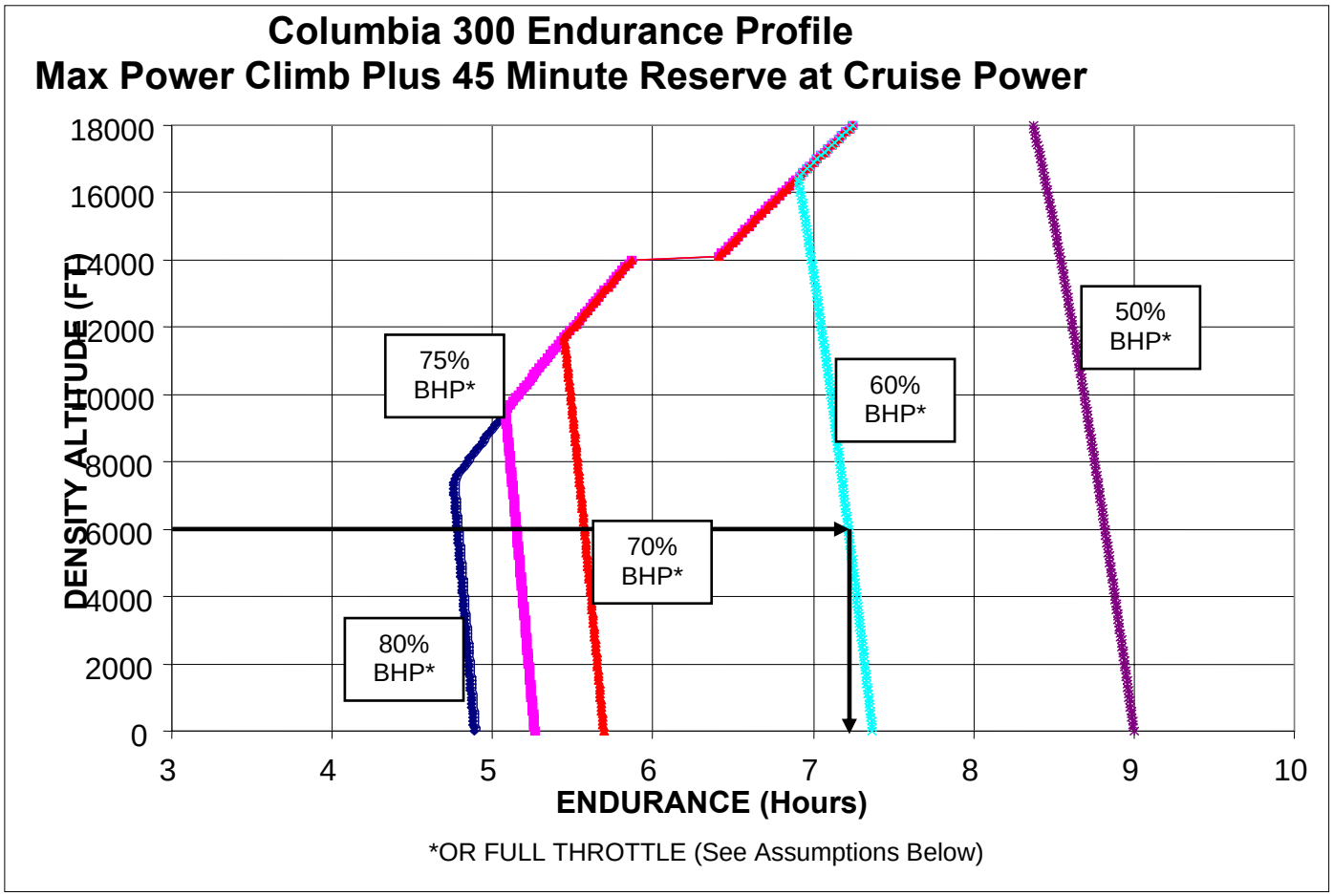


(Figure 5-20)

Conditions	Assumptions	Note
3400 lbs. (1542 kg) Max. Gross Weight Standard Temperature Proper Leaning Full Fuel Tanks – 98 Gallons (371 L)	Chart assumes applicable BHP is maintained until full throttle is reached. After that, BHP will decrease with altitude.	The chart includes fuel for starting the engine, taxi, takeoff, and climb to altitude. The 45 minute reserve allowance is based on the applicable percentage of BHP for 45 minutes.

Example: At a density altitude of 6000 feet, with a 60% BHP power setting, the range is approximately 1175 miles.

ENDURANCE PROFILE



(Figure 5-21)

Conditions	Assumptions	Note
3400 lbs. (1542 kg) Max. Gross Weight Standard Temperature Proper Leaning Full Fuel Tanks – 98 Gallons (371 L)	Chart assumes applicable BHP is maintained until full throttle is reached. After that, BHP will decrease with altitude.	The chart includes fuel for starting the engine, taxi, takeoff, and climb to altitude. The 45 minute reserve allowance is based on the applicable percentage of BHP for 45 minutes.

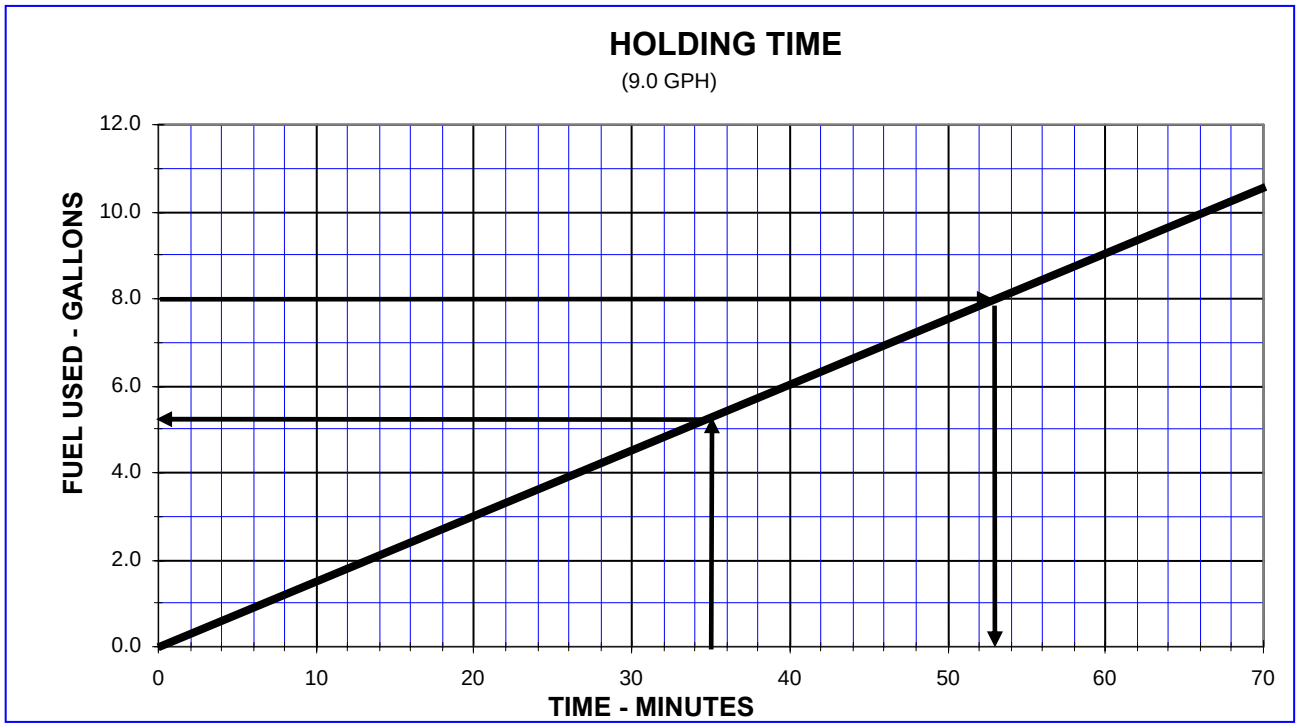
Example: At a density altitude of 6000 feet, with a 60% BHP power setting, the endurance is approximately 7.2 hours.

HOLDING CONSIDERATIONS

When holding is required, it is recommended that takeoff flaps be used with an indicated airspeed of 120± knots. Depending on temperature, gross weight, and RPM, the manifold pressure will range from about 13 to 17 inches. The fuel consumption has wide variability as well and can range from about 8 to 10 GPH (30.3 to 37.9 LPH). The graph below, (Figure 5-22), provides information to calculate either fuel used for a given holding time or the amount of holding time available for a set quantity of fuel.

The graph is based on a fuel consumption of 9 GPH (34.1 LPH) and is included here to provide a general familiarization overview. Under actual conditions, most pilots can perform the calculation for *fuel used* or the *available holding time* without reference to the graph. Moreover, the graph is only an approximation of the average anticipated fuel consumption. There will be wide variability under actual conditions.

In the example below, a 35-minute holding time will use about 5.2 gallons (19.7 L) of fuel. Conversely, if only 8 gallons (30.3 L) of fuel are available for holding purposes, the maximum holding time is 53 minutes before other action must be taken. Note that this is about the amount of fuel remaining in a tank when the low-level fuel warning light illuminates.



(Figure 5-22)

TIME, FUEL, AND DISTANCE FOR CRUISE DESCENT

The table below (Figure 5-23) has information to assist the pilot in estimating cruise descent times, fuel used, and distance traveled from cruise altitude to sea level or to the elevation of the destination airport. For descents from cruise altitude to sea level, locate the cruise altitude for the descent rate in use and read the information directly. This data is determined for a weight of 3000 lbs. but is representative of normal operating weights during descent.

For example, a descent at 500 FPM from 9000 feet to sea level will take approximately 18 minutes, consume 1.3 gallons of fuel, and 57 miles will be traveled over the ground under no wind conditions. For descent from cruise altitude to a field elevation above sea level, subtract the performance data numbers for the field elevation from the respective cruise altitude numbers. Suppose in this example that the descent from 9000 feet is not to sea level, but rather to a field pressure altitude of 3000 feet. In this instance, the descent time is 12 minutes (18 – 6 = 12), the fuel used is 0.9 gallons (1.3 – 0.4 = 0.9), and the distance covered is 39 nm (57 – 18 = 39).

Power will be at 50% BHP± and lower, depending on altitude. As altitude decreases, power must be reduced and the mixture set to a slightly richer setting. The pilot should be aware of the limitation on V_{NO} at altitudes above 12000 feet MSL and adjust indicated airspeed accordingly, if flying in other than smooth air. See (Figure 2-1) for airspeed limitations and page 1-6 for the definition of V_{NO}.

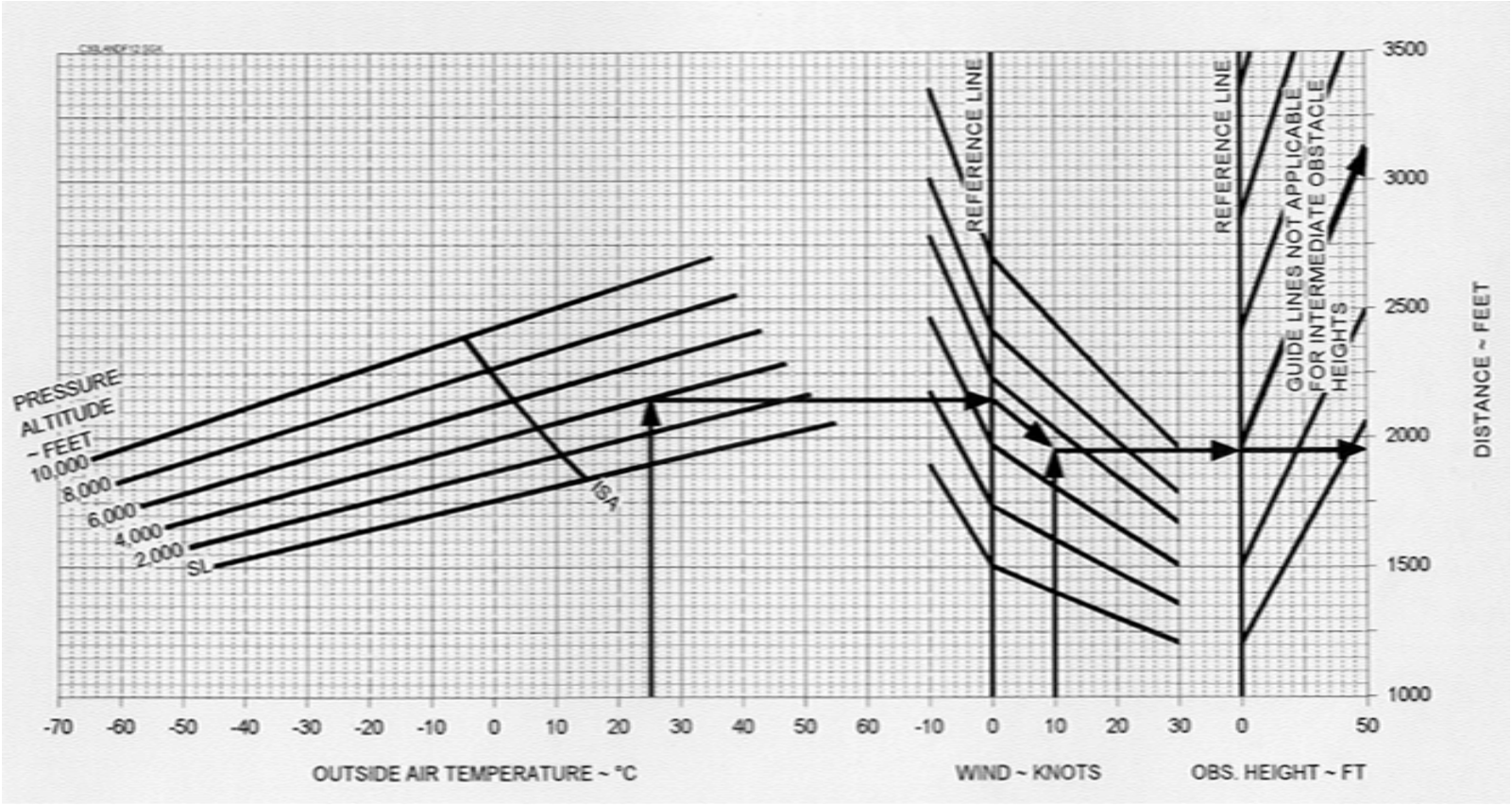
	180 KIAS 500 FPM DESCENT Rate (No Wind – Standard Temperature)				**180 KIAS 1000 FPM DESCENT Rate (No Wind – Standard Temperature)**			
Pressure Altitude	KTAS	Time Min	Fuel Used Gal. (L)	Distance NM	KTAS	Time Min	Fuel Used Gal. (L)	Distance NM
15000	-	-	-	-	227	15	2.4 (9.1)	50
14000	-	-	-	-	223	14	2.2 (8.3)	46
13000	-	-	-	-	220	13	2.0 (7.6)	42
12000	-	-	-	-	216	12	1.8 (6.8)	38
11000	212	22	1.6 (6.1)	71	212	11	1.7 (6.4)	35
10000	209	20	1.4 (5.3)	64	209	10	1.5 (5.7)	32
9000	206	18	1.3 (4.9)	57	206	9	1.3 (4.9)	28
8000	203	16	1.1 (4.2)	50	203	8	1.2 (4.5)	25
7000	200	14	1.0 (3.8)	44	200	7	1.0 (3.8)	21
6000	197	12	0.9 (3.4)	37	197	6	0.9 (3.4)	18
5000	194	10	0.7 (2.6)	31	194	5	0.7 (2.6)	15
4000	191	8	0.6 (2.3)	24	191	4	0.6 (2.3)	12
3000	188	6	0.4 (1.5)	18	188	3	0.4 (1.5)	9
2000	185	4	0.3 (1.1)	12	185	2	0.3 (1.1)	6
1000	183	2	0.1 (0.4)	6	183	1	0.1 (0.4)	3
0	180	0.0	0.0 (0.0)	0.0	180	0.0	0.0 (0.0)	0.0

(Figure 5-23)

SHORT FIELD LANDING DISTANCE (12º - LANDING FLAPS)

ASSOCIATED CONDITIONS		EXAMPLE	
Power	As Required to Maintain 3º Approach	Outside Air Temperature (OAT)	25º C
Flaps	12º (Flaps in Takeoff Position)	Pressure Altitude (PA)	4000 Ft.
Runway	Paved, Level, Dry Surface	Headwind Component	10 Knots
Approach Speed	88 KIAS ($V_{at\ 50\ ft.}$ Speed 88 KIAS All Weights)	**Ground Roll**	**1950 Ft. (594 m)**
Braking	Maximum	**Total Distance Over 50 Ft. Obstacle**	**3120 Ft. (951 m)**

For operation on a known level, smooth, mowed grass runway, which is either wet or dry but does not include standing water, the ground roll distance obtained from this landing performance chart must be multiplied by a factor of 1.6 to obtain the correct field length. In the above example, the ground roll distance would be 3,120 feet (951 m) (1.6 x 1950). In this instance, the total landing distance from a 50 foot (15 m) obstacle would be 4,290 feet (1308 m).

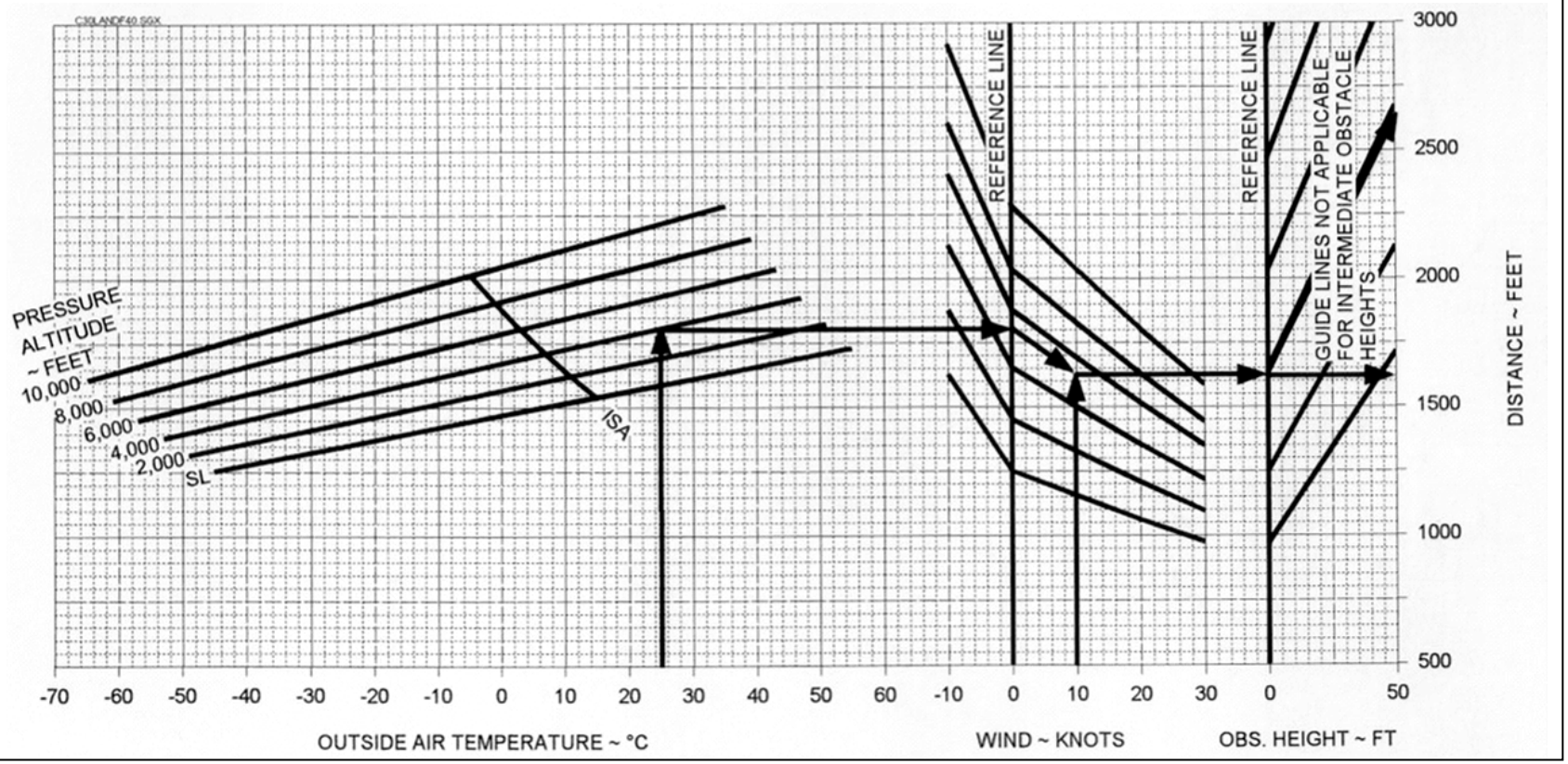


(Figure 5-24)

SHORT FIELD LANDING DISTANCE (40º - LANDING FLAPS)

ASSOCIATED CONDITIONS		EXAMPLE	
Power	As Required to Maintain 3º Approach	Outside Air Temperature (OAT)	25º C
Flaps	40º (Flaps in Takeoff Position)	Pressure Altitude (PA)	4000 Ft.
Runway	Paved, Level, Dry Surface	Headwind Component	10 Knots
Approach Speed	78 KIAS ($V_{at\ 50\ ft.}$ Speed 78 KIAS All Weights)	**Ground Roll**	**1620 Ft. (494 m)**
Braking	Maximum	**Total Distance Over 50 Ft. Obstacle**	**2650 Ft. (808 m)**

For operation on a known level, smooth, mowed grass runway, which is either wet or dry but does not include standing water, the ground roll distance obtained from this landing performance chart must be multiplied by a factor of 1.6 to obtain the correct field length. In the above example, the ground roll distance would be 2,592 feet (790 m) (1.6 x 1620). In this instance, the total distance from a 50 foot (15 m) obstacle would be 3,622 feet (1104 m).



(Figure 5-25)

SAMPLE PROBLEM

Airplane Configuration	Cruise Environment
Takeoff Weight ... 3400 lbs. (1542 kg) Maximum Gross Weight Usable Fuel ..... 98 Gallons (371 L)	Distance of Trip..... 412 Nautical Miles Pressure Cruise Altitude ..... 8000 Feet Cruise Power..... 80% BHP Ambient Air Temperature ..... -1°C (Standard) En route Winds ..... 30 Knot Headwind
Takeoff Environment	**Landing Environment**
Airport Pressure Altitude..... 3500 Feet Ambient Air Temperature ..... 25°C (17°C above standard) Headwind Component ..... 30 Knots Runway Length ..... 3000 Feet Obstacle at the end of the runway..... 50 Feet Climb to Cruise Altitude..... Max. Continuous Power	Airport Pressure Altitude ..... 2000 Feet Ambient Air Temperature ..... 30°C (16.5°C above standard) Landing Runway Number ..... 36 Wind Direction & Velocity ..... 040º at 25 Knots Runway Length ..... 3000 Feet Obstacle at approach end of the runway..... None

SOLVE FOR THE FOLLOWING ITEMS

No.	Item	Solution	Comments
1.	What is the takeoff ground run distance at the departure airport?	725± Feet	Problem is different than example arrows, i.e., takeoff weight - 3400 lbs. and headwind - 30 knots.
2.	What is the total takeoff distance at the departure airport (ground run and obstacle clearance)?	1400± Feet	Major indices are 500 and minor indices (not printed on the graph) are 250 feet. Each line is 50 feet.
3.	Assume a climb to cruise altitude is started at a pressure altitude of 4000 feet. What is the approximate fuel used to reach cruise altitude?	1.2 Gallons (4.5 L)	The fuel required to reach a pressure altitude of 4000 and 8000 feet is 1.5 and 2.7 gallons, respectively. The difference between these two altitudes yields 1.2 gallons. No adjustment for non-standard temperature is possible.
4.	What distance over the ground is covered in the climb under no wind conditions? What is the approximate time?	8.5 Miles 4.2 Minutes	Using the technique described in No. 3 subtract the 4000 pressure altitude distance/time from the 8000 pressure altitude distance/time.
5.	What is the fuel flow at the 8000 foot cruise altitude?	17.2 GPH (65.1 LPH)	Basic interpolation problem between 81% and 76% BHP.
6.	What is the true airspeed at the 8000 foot cruise altitude (to the nearest whole knot)?	190 knots	Basic interpolation problem between 81% and 76% BHP.
7.	Using the cruise and range profiles, what are the approximate miles covered and time aloft at 80% BHP.	910 NM 4.8 Hours	Notice that range and endurance are significantly reduced when operating at higher power settings.
8.	If 30 minutes of holding is required at the destination airport, how much fuel is used.	5.1 Gallons (19.3 L)	When holding it is recommended that the fuel flow be set to 10.2 GPH (38.6 LPH).
9.	Assume a 500 FPM descent is used for arrival at the destination airport. At what distance from the airport should the descent begin to arrive at 1000 feet above the surface?	32 Miles	The airport elevation is 2000 feet and the descent is from 8000 feet; hence, calculations should compare 8000 feet with 3000, which is 1000 feet above the surface. See the instruction on page 5-22 for descents to airports above sea level.
10.	What are the crosswind and headwind components at the destination airport?	16 kts xwind 19 kts hdwnd	The wind is 40º off the runway centerline. See (Figure 5-6) for a detailed explanation.
11.	What is the landing distance required at the destination airport, with landing flaps?	1450± Feet	In No. 10 above, the headwind component is 19 knots. Insert this information along with the airport elevation and temperature into (Figure 5-24).
12.	What is the landing distance required at the destination airport, with takeoff flaps?	1800± Feet	In No. 10 above, the headwind component is 19 knots. Insert this information along with the airport elevation and temperature into (Figure 5-25).

SOLVE FOR THE FOLLOWING ITEMS			
No.	**Item**	**Solution**	**Comments**
13.	Assume that the destination airport has a 50 foot obstacle and the strong crosswind limits flap usage to the takeoff setting, is landing at the destination a prudent action?	No	Under these circumstances, the required runway is almost 2800 feet, which leaves a cushion of only 200 feet.

Section 6
Weight & Balance
&
Equipment List (Appendix A)

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Section 6
Weight & Balance/Equipment List

INTRODUCTION

Weight and Balance Procedures – This section, after the introduction, is divided into three parts. The first part contains procedures for determining the empty weight and empty center of gravity of the airplane. Its use is intended primarily for mechanics and companies or individuals who make modifications to the airplane. While the procedures are not directly applicable for day-to-day pilot use, the information will give the owner or operator of the airplane an expanded understanding of the weight and balance procedures.

The procedures for determining the empty weight and empty CG are excerpted from the maintenance manual and included in *Pilot's Operating Handbook* to aid those who need to compute this information but do not have access to a maintenance manual. This section also contains procedures for maintaining and updating weight and balance changes to the airplane. While a mechanic or others who make changes to the airplane's configuration normally update the section, the pilot, owner, and/or operator of the airplane are responsible for ensuring that the information is maintained in a current status. The last entry on this table should contain the current weight and moments for this airplane.

The second part of this section is applicable to pilots, as it has procedures for determining the weight and balance for each flight. This part details specific procedures for airplane loading, how loading affects the center of gravity, plus a number of charts and graphs for determining the loaded center of gravity.

For pilot purposes, in the Lancair Columbia 300 (LC40-550FG), the datum point is at or near the tip of the propeller spinner. All measurements from this point are positive or aft of the datum point and are expressed in inches. It is important to remember that the weight and balance for each airplane varies somewhat and depends on a number of factors. The weight and balance information detailed in this manual only applies to the airplane specified on the cover page.

This weight and balance information is part of the *FAA Approved Airplane Flight Manual* (AFM). Under the provision of Part 91 of the Federal Aviation Regulations no person can operate a civil aircraft unless there is available in the aircraft a current AFM. (U.S. operating rules do not apply in Canada.) It is the responsibility of the pilot in command to ensure that the airplane is properly loaded.

Equipment List – The final portion of this section contains the equipment list. The equipment list includes standard and optional equipment and specifies both the weight of the installed item and its arm, i.e., distance from the datum. This information is useful in computing the new empty weight and CG when items are temporarily removed for maintenance or other purposes. In addition, equipment required for a particular flight operation is tabulated. The equipment is generally organized and listed in accordance with ATA maintenance manual chapter numbering specifications.

PROCEDURES FOR WEIGHING & DETERMINING EMPTY CG

GENERAL

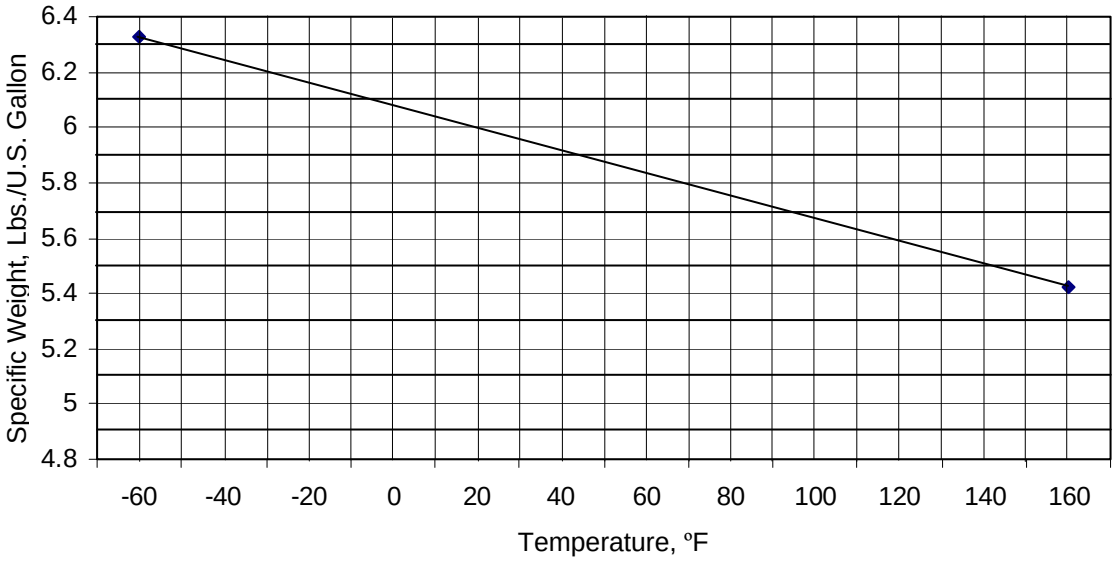
To determine the empty weight and center of gravity of the airplane, the airplane must be in a level area and in a particular configuration.

AIRPLANE CONFIGURATION (Empty Weight)

1. The airplane empty weight includes eight quarts of oil (dipstick reading), unusable fuel, hydraulic brake fluid, and installed equipment.
2. Defuel airplane per instruction in Chapter 12 of the maintenance manual.
3. Ensure the oil sump is filled to eight quarts (Cold engine). Check the reading on the dipstick and service as necessary.
4. Place the pilot's and front passenger's seat in the full aft position.
5. Retract the flaps to the up or 0° position.
6. Center the controls to the neutral static position.
7. Ensure all doors, including the baggage door, are closed when the airplane is weighed.

CAUTION

It is not recommended to weigh an airplane with full fuel and subtract the weight of the fuel to obtain empty weight because the weight of fuel varies with temperature. If this method of weight determination is used, fuel weight should be calculated conservatively. Use the specific weight of fuel at ambient temperature. See table and example below.



Average Specific Weight of Aviation Gasoline (Mil-F-5572 Grade 100/130 Type) Versus Temperature

The following is offered as an example only. It is important to remember that the aircraft weight in the example does not apply to a specific airplane.

Example:

Unconservative Calculation
Conventionally used fuel specific weight (6 lbs./U. S. gal.)
Total Aircraft weight with fuel = 3038 lbs.
Weight of fuel (98 gal. x 6 lbs./U. S. gal.) = 588 lbs.
Airplane empty weight (3038 lbs – 588 lbs.) = 2450 lbs.

Unconservative Calculation
Fuel specific weight at 60 ºF (5.83 lbs./U. S. gal.)
Total Aircraft weight with fuel = 3038 lbs.
Weight of fuel (98 gal. x 5.83 lbs./U. S. gal.) = 571 lbs.
Airplane empty weight (3038 lbs – 571 lbs.) = 2467 lbs.

AIRPLANE LEVELING

Since there are no perfectly level reference areas on the airplane and the use of Smart Levels is not common, the airplane is leveled by use of a plumb bob suspended over a fixed reference point in the baggage compartment. Moreover, since the use of jacks with load cells is not prevalent, the wheel scales method is described in this manual. The following steps specify the procedures for installing the plumb bob and leveling the airplane. These steps must be completed before taking readings from the wheel scales.

1. The airplane must be weighed in a level area.
2. Remove the left rear seat cushion and place in the footwell. When the cushion is removed, a small washer, which is bonded to the bottom of the seat frame, will be exposed.

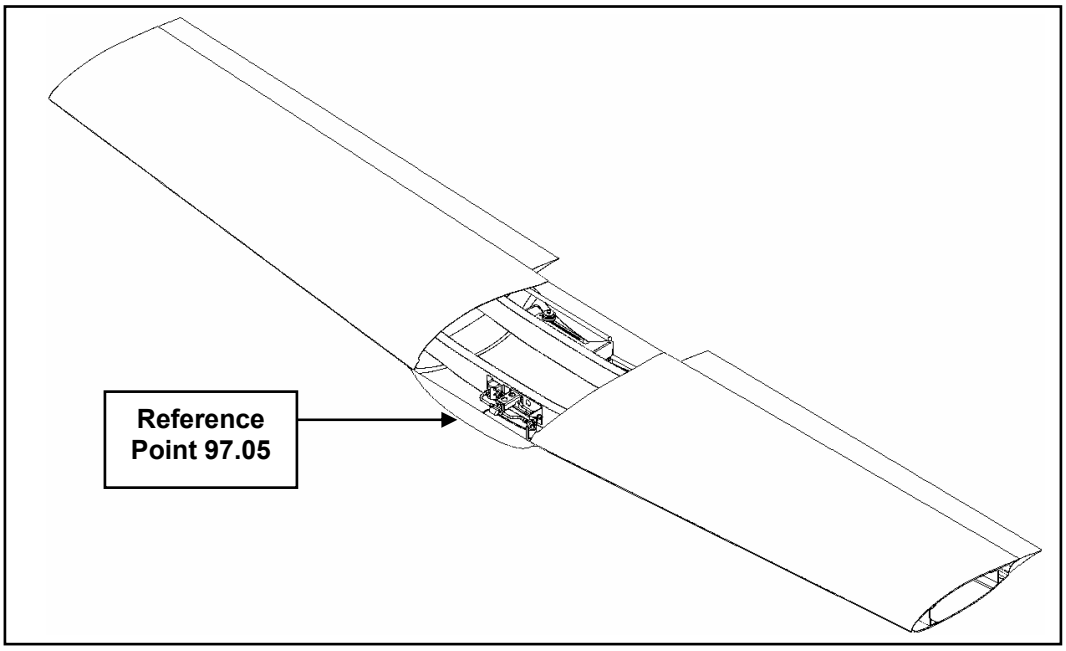
(Figure 6-1)

3. Using a string with a plumb bob attached to it, run the string over the gas strut door flange between the flange ball and the point where the gas strut attaches to the ball and tie the string off around the front seatbelt bracket. See (Figure 6-1).
4. Using the two jack method (Raising Both Wings) discussed in Chapter 7 of the maintenance manual, position the two main tires and the nose tire of the airplane on three scales. Ensure the brakes are set before raising the airplane off the floor. When all of the airplane's weight is on the three scales, move the jacks to a location that is not under the wings. The pointed end of the plumb bob, in a resting state, will be near a 3/16-inch washer bonded into the seat frame.

5. It will be necessary to either deflate the nose tire or strut and/or main tires to center the plumb bob point over the washer. When the pointer of the plumb bob is over any part of the washer, the airplane is level.
6. Once the airplane is level, be sure to release the brakes.

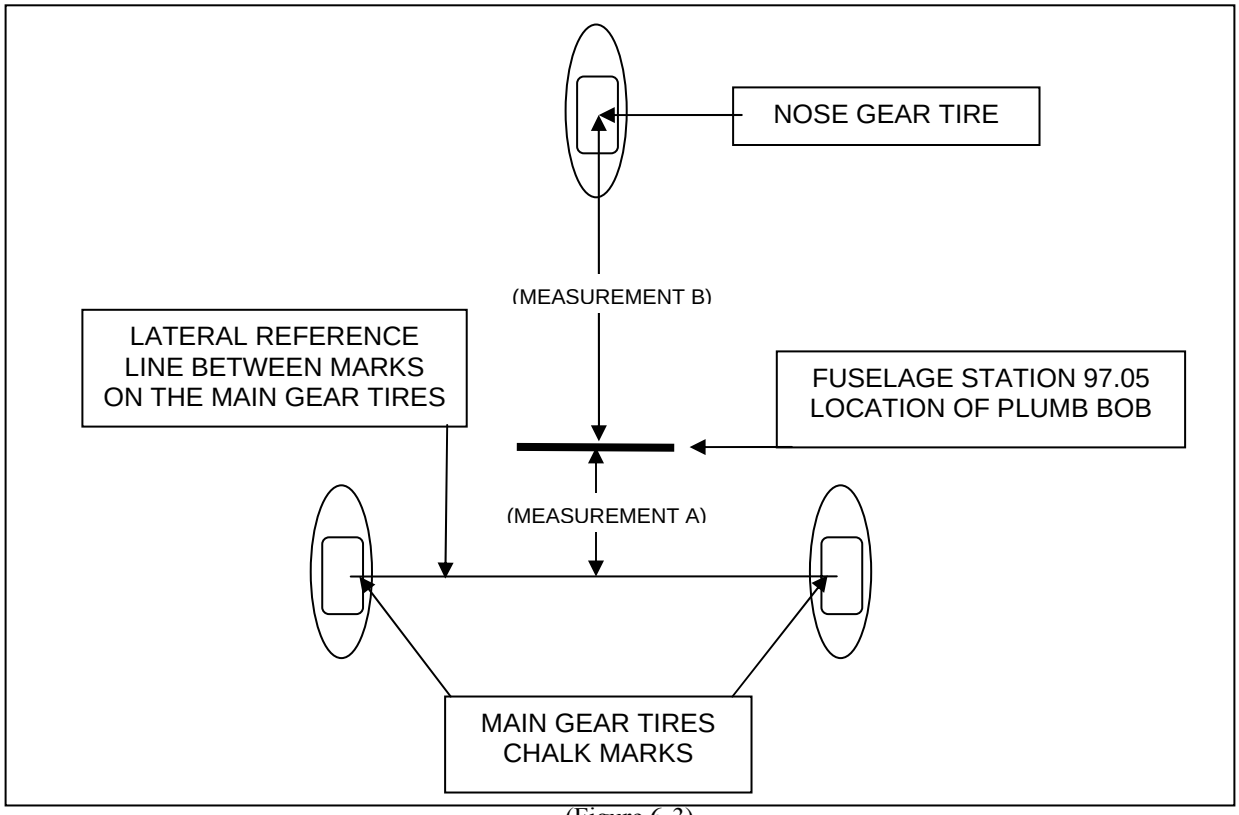
USING THE PERMANENT REFERENCE POINT

To determine the empty weight center of gravity of the airplane, it is more convenient to work with the permanent reference. The permanent reference point on the airplane is located at the forward part of the wing bottom, in the center of the wing saddle and is 97.05 inches aft of the datum. The location is shown in (Figure 6-2). There is a pronounced seam at the point where the fuselage is attached to the wing, and the leading edge of the wing bottom is easy to identify. Suspend a plumb bob from the permanent reference point in the exact center as shown in (Figure 6-2) through (Figure 6-4).



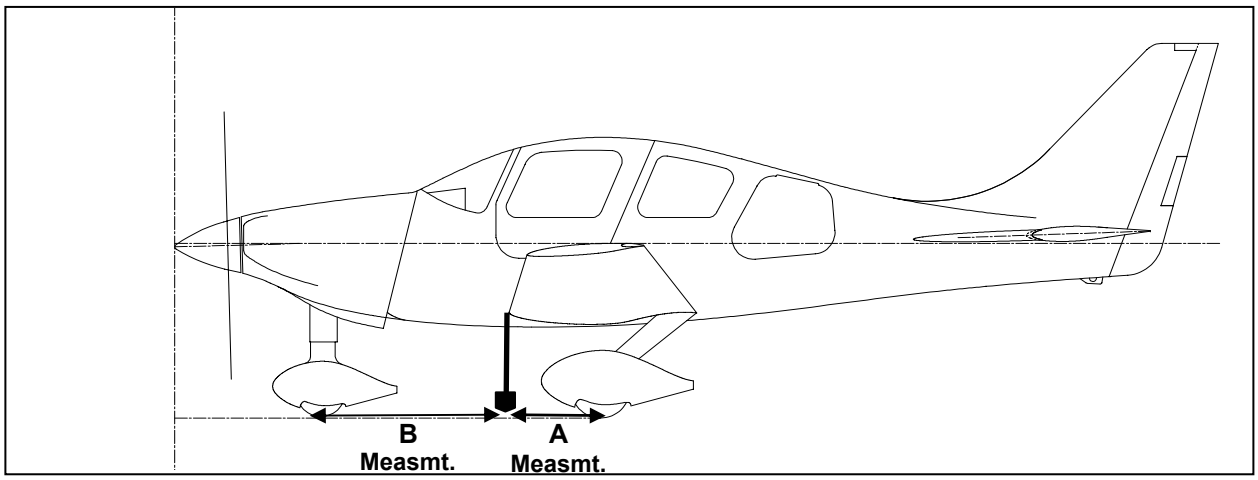
(Figure 6-2)

1. Determine the center point on each tire, and make a chalked reference mark near the bottom where the tire touches the floor. On the main gear tires, the mark should be on the inside, near where the arrows point in (Figure 6-3).


NOSE GEAR TIRE
(MEASUREMENT B)
LATERAL REFERENCE LINE BETWEEN MARKS ON THE MAIN GEAR TIRES
FUSELAGE STATION 97.05 LOCATION OF PLUMB BOB
(MEASUREMENT A)
MAIN GEAR TIRES CHALK MARKS

(Figure 6-3)

2. Create a lateral reference line between the two main gear tires. This can be accomplished by stretching a string between the two chalk marked areas of the tires, snapping a chalk line between these two points, or laying a 7.3 foot board between the points.



(Figure 6-4)

MEASUREMENTS

Measure the distance along the longitudinal axis from the permanent reference point (tip of the plumb bob) to the lateral reference line between the main gear tires. This is Measurement A in (Figure 6-3) and (Figure 6-4). Measure the distance along the longitudinal axis between the plumb bob to the mark on nose tire. This is Measurement B in (Figure 6-3) and (Figure 6-4).

CONVERTING MEASUREMENTS TO ARMS

To convert Measurement A and B distances to an arm, use the formulas shown in (Figure 6-5) and (Figure 6-6), respectively.

MAIN GEAR

Measurement A Distance + 97.05 inches = Main Gear Arm

(Figure 6-5)

NOSE GEAR

97.05 inches - Measurement B Distance = Nose Gear Arm

(Figure 6-6)

WEIGHTS AND COMPUTATIONS

Each main gear scale should be capable of handling weight capacities of about 1200 lbs., while the nose gear scale needs a capacity of at least 750 lbs. Computing the total weight and moments requires seven steps or operations. These seven operations are discussed below and also shown in (Figure 6-7).

	Operation No. 1	Operation No. 2	Operation No. 3		Operation No. 4		Operation No. 5
Scale Location	Weight Reading (lbs.)	Tare or Scale Error	Corrected Weight (lbs.)	X	Arm (Inches)	=	Moments (lbs.- inches)
Right Main Gear	Right Scale Reading	Scale Error	Right Scale Wt. ± Error	X	Main Gear Arm	=	Right Gear Moments
Left Main Gear	Left Scale Reading	Scale Error	Left Sale Wt. ± Error	X	Main Gear Arm	=	Left Gear Moments
Nose Gear	Nose Scale Reading	Scale Error	Nose Scale Wt. ± Error	X	Nose Gear Arm	=	Nose Gear Moments
Total Empty Weight and Empty Moments			Total Corrected Weight Operation No. 6				Total Moments Operation No. 7

(Figure 6-7)

1. **Operation No. 1** - Enter the weight for each scale into the second column.
2. **Operation No. 2** - Next, enter the scale error. The scale error is sometimes referred to as the tare and is entered in the third column for each scale.
3. **Operation No. 3** - Add or subtract the respective tare for each scale, and enter the result into the fourth column. This is the correct weight.
4. **Operation No. 4** - Using the formulas shown in (Figure 6-5) and (Figure 6-6), determine the arm for the main gear and nose gear. Enter this information into the fifth column.
5. **Operation No. 5** - Multiply the corrected scale weights times their respective arms to determine the moments for each location. Enter the moments for each computation in the sixth column.
6. **Operation Nos. 6 and 7** – Sum the weights in the fourth column and the moments in the sixth column. Note: The areas of primary calculations have a double outline.

7. The final step, which is to determine the empty center of gravity, is to divide the total moments by the total corrected weight. A detailed example of this computation is shown in (Figure 6-9).

EXAMPLE OF EMPTY CENTER OF GRAVITY (CG) DETERMINATION

The following is offered as an example problem to aid in understanding the computation process. It is important to remember that the weights, arms, and moments used in the example problem are for demonstration purposes only and **do not** apply to a specific airplane. For the example problem, assume the following.

1. Scale Weights
   a. Right Main Gear – 887 pounds
   b. Left Main Gear – 886 pounds
   c. Nose Gear – 522 pounds
2. Scale Error (Tare)
   a. Right Main Gear Scale is –2 pounds
   b. Left Main Gear Scale is –1 pound
   c. Nose Gear Scale is + 3 pounds
3. Measurements
   a. Measurement Distance A is 24.05 inches
   b. Measurement Distance B is 56.15 inches
   c. These uncorrected scale weights and tares are shown in (Figure 6-8). Note that after correcting for scale error, the right, left, and nose gear weights are 885.0, 885.0, and 525.0 pounds, respectively.
   d. The arm for the main gear is computed as follows using the formula in (Figure 6-5).

Measurement distance A + 97.05 inches = Main Gear Arm (MGA)
or
24.05 inches + 97.05 inches = 121.1 inches MGA

4. The arm for the nose gear is computed as follows using the formula in (Figure 6-6).

97.05 inches – Measurement Distance B = Nose Gear Arm (NGA)
or
97.05 inches – 56.15 inches = 40.9 inches NGA

5. The main and nose gear arms, as computed, are shown in (Figure 6-8).
6. The corrected weights of 885 pounds are then multiplied with the 121.1 inch main gear arm, which produces total moments of 107,173.5 lbs.-inches. In this example the moments are the same for both the right and left gear since the weights are the same. However, it is not uncommon for the right and left gear weights to vary a few pounds.
7. Next, the corrected 525 pound nose gear weight is multiplied times its 40.9 inch arm, which produces a moment value of 21,472.5 lbs.-inches.
8. Finally, the total moments and corrected weight are summed. In the example below, the total weight is 2,295 pounds and the total moments are 235,819.5 lbs.-inches. All this information is summarized in (Figure 6-8). All required data for determining the empty center of gravity are now available.

Scale Location	Weight Reading (lbs.)	Tare or Scale Error	Corrected Weight (lbs.)	X	Arm (Inches)	=	Moments (lbs.- inches)
Right Main Gear	887	- 2	885.0	X	121.1	=	107,173.5
Left Main Gear	886	-1	885.0	X	121.1	=	107,173.5
Nose Gear	522	+3	+525.0	X	40.9	=	+21,473.5
Total Empty Weight and Empty Moments			2295.0				235,819.5 (Rounded) 235,820

(Figure 6-8)

9. The formula for determining empty weight center of gravity is shown in (Figure 6-9); in the example below, the empty center of gravity of the airplane is at fuselage station (FS) 102.75.

$$\frac{Total\ Moments}{Empty\ Weight} = Center\ of\ Gravity \quad or \quad \frac{235{,}820\ lbs. - inches}{2{,}295\ lbs.} = 102.75\ inches$$

(Figure 6-9)

CHANGES IN THE AIRPLANE'S CONFIGURATION

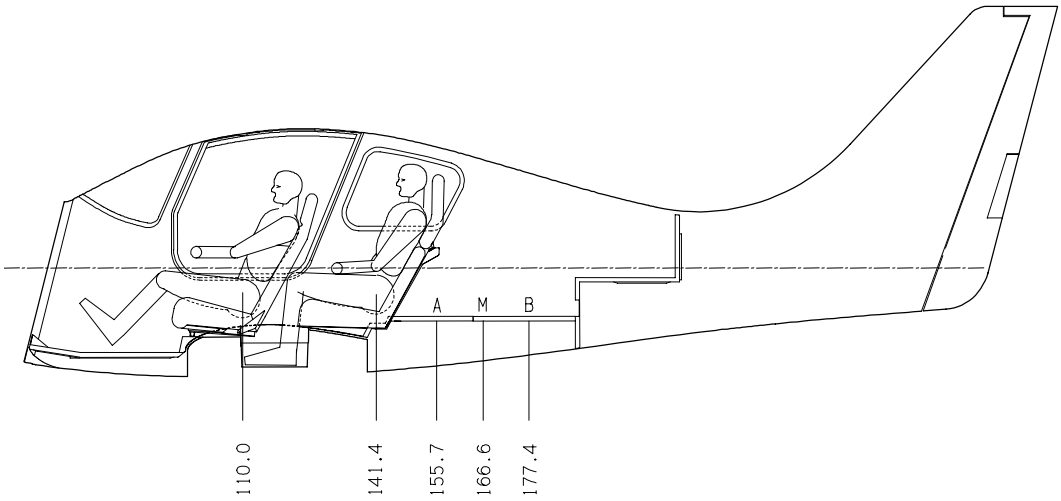
1. **Determining Location (FS) of Installed Equipment in Relation to the Datum –** If equipment is installed in the airplane, the weight and balance information must be updated. Individuals and companies who are involved with equipment installations and/or modifications are generally competent and conversant with weight and balance issues. These individuals or companies must be aware that the fixed reference point is located at fuselage station (FS) 97.05. Please see (Figure 6-2) on page 6-6 for more information.
2. **Weight and Balance Forms –** There is a form that is inserted after Appendix A of Chapter 6 of the *AFM/POH* that is used to track changes in the configuration of the airplane. When equipment is added or removed, these pages or an appropriate approved form must be updated. In either instance the required information is similar.
3. **Updating The Form –** Fill in the date the item is added or removed, a description of the item, the arm of the item, its weight, and the moment of the item. Remember, multiply the weight times the arm of the item to obtain the moment. Finally, compute the new empty weight and empty moment by adjusting the running totals. If an item is removed, subtract the weight and moment of the item from the running totals. If an item is added, add the weight and moment of the item to the running totals.

PROCEDURES FOR DETERMINING GROSS WEIGHT AND LOADED CENTER OF GRAVITY (CG)

USEFUL LOAD AND STATIONS

The useful load is determined by subtracting the empty weight of the airplane from the maximum allowable gross weight of 3400 pounds. The current information obtained from the Weight & Balance Record in the previous discussion contains the empty weight and empty moments for this airplane. The useful load includes the weight of pilot, passengers, usable fuel, and baggage.

The objective in good weight and balance planning is to distribute the useful load in a manner that keeps the loaded center of gravity within prescribed limits and near the center of the CG range. The center of gravity is affected by both the amount of weight added and the arm or distance from the datum. The arm is sometimes expressed as a station. For example, if weight is added at station 110, this means the added weight is 110 inches from the datum or zero reference point. The drawing below (Figure 6-10) shows the location of passenger and baggage loading stations. The fuel is loaded at station 118 and is not shown in the figure. These loading stations are summarized in (Figure 6-12).



(Figure 6-10)

BAGGAGE

The space between the rear seat and the aft bulkhead is referred to as the main baggage area, and the shelf aft of this area is called the hat rack or simply the shelf. In (Figure 6-10) and (Figure 6-12) there are listings for three main area baggage stations, which are labeled A, M, and B. Area A is the forward baggage zone and area B is the aft baggage zone. Point M is the middle point of the baggage compartment. The arm for the shelf is measured from the datum point to the center portion of the shelf.

Since the main baggage area, exclusive of the hat rack, is about three and one half feet in length, consideration must be given to the arm of weights placed within this area. The use of multiple baggage loading stations contribute to more precise center of gravity computations and facilitate redistribution of baggage when the aft CG limit is exceeded. If no weight is placed on the hat

rack, then up to 120 lbs. can be placed in either zone or distributed evenly over the main baggage area. This, of course, assumes that the placement of such weight does not exceed the maximum gross weight or the center of gravity limitations.

The floor attachment points define the physical limits of each zone. That is, the area between the forward and middle cross strap defines Zone A, and the middle cross strap and aft attachment points define Zone B. There is a cargo net in the airplane that secures the contents in the baggage compartment in three basic configurations. The table below (Figure 6-11) summarizes the three different arrangements. The term "bubble" refers to the shape of the cargo net.

BAGGAGE CONFIGURATION TABLE

NO.	ZONE	CONFIGURATION OF CARGO NET	APPLICABLE ARM
1.	A Only	Single forward bubble, anchored at the forward and middle attachment points.	155.7 inches
2.	A and B	Double bubble, anchored at forward, middle, and aft attachment points	155.7 and 177.4 inches times respective weights
3.	Main Area	Weight is evenly distributed over the main baggage area. There can be one or two bubbles depending on the shape of the baggage.	166.6 inches

(Figure 6-11)

Baggage is always loaded in the forward area first (Zone A). Heavier items, of course, should be placed near the floor, regardless of loading area, and never load the baggage compartment to a level higher than the top of the hat rack. If only Zone A is utilized, the computations are based on an arm of 155.7 inches. If both Zones A and B are utilized, with defined weights in each area as shown in Configuration No. 2 in (Figure 6-11), two computations will be made to determine the total baggage weight and moments.

In this situation, each zone will have a significantly different quantifiable weight. For example, assume that 100 lbs. are loaded in Zone A and 20 lbs. in Zone B. These combined weights and respective arms produce a baggage CG of 159.3, over seven inches forward of the middle point of the baggage area. Conversely, if the respective Zone A and B weights are 55 and 65 lbs., the baggage CG moves less than one inch from the middle CG point. As a general rule, if the weights placed in Zones A and B do not vary more than 15%, then the middle CG arm of 166.6 can be used to compute the main baggage area moment.

BAGGAGE NETS

The airplane has two baggage nets. The hat rack net secures items placed on the hat rack. The floor net secures items in the main baggage area. A summary of the two nets follows.

1. **The floor net** provides a total of four anchoring points. The points are all on the floor with two behind the back seat and two just below the hat rack bulkhead. In addition, the floor net can be adjusted at any one of the four straps at the attachment points by pressing on the cinch and sliding the strap. The net can be removed by releasing each of the four attachments by pressing down and holding on the button on the top of the attachment and sliding it out of its mount. The net can be reinstalled by reversing the removal process. The floor net must be used any time baggage is carried in the main baggage compartment area.

2. **The hat rack net** is attached at four points, two in the overhead and two on the face of the hat rack bulkhead. The net is not adjustable. To remove the net, unhook each of the four hook attachments from the mounting slot. To attach the net, hook each of the four hook attachments into the mounting slot. This net must be used anytime items are stored in the hat rack area.

SUMMARY OF LOADING STATIONS

Description	Arm (Inches From Datum)	Maximum Weight
Front Seat Pilot and Passenger	110.0 inches	N/A
Rear Seat Passenger(s)	141.4 inches	N/A
Fuel	118.0 inches	588 Lbs. (98 Gallons*)
Forward Baggage Area (Zone A)	155.7 inches	120 lbs.
Middle of Baggage Area (Point M)	166.6 inches	120 lbs.
Aft Baggage Area (Zone B)	177.4 inches	120 lbs.
Center Rear Baggage Shelf	199.8 inches	20 lbs.

*Usable Fuel (The 8 gallons of unusable fuel is included in the empty weight.)

†The maximum total allowed baggage weight is 120 lbs., and only 20 lbs. of this total allowable weight can be placed on the rear baggage shelf. The weight of items placed on the rear shelf must be subtracted from 120 lbs. of total allowable baggage weight.

(Figure 6-12)

COMPUTING THE LOADED CENTER OF GRAVITY (CG)

All information required to compute the center of gravity as loaded with passengers, baggage, and fuel is now available. Refer to the sample-loading problem in (Figure 6-13). This table is divided into two sections; the first section contains a sample-loading problem with computations, and the second section provides space for actual calculations. It is recommended that the second section of this table be copied or otherwise duplicated so that the pilot has an unmarked document with which to perform the required calculations.

CALCULATOR METHOD

Sample Problem Calculator Method				**Actual Calculation For This Airplane**			
ITEM	WT. (Lbs.)	ARM (Inches)	MOMENTS (lbs.-in.)	ITEM	WT. (Lbs.)	ARM (Inches)	MOMENTS (lbs.-in.)
Basic Empty Wt.**	2,295		235,820	Basic Empty Wt.			
Front Seat Wts.	380	110.0	41,800	Front Seats		110.0	
Rear Seats Wts.	175	141.4	24,745	Rear Seats		141.4	
Baggage (Main)	50	166.6	8,330	Baggage (Main)*		166.6	
Baggage (Zone A)	0	155.7	0	Baggage (Zone A)*		155.7	
Baggage (Zone B)	0	177.4	0	Baggage (Zone B)*		177.4	
Baggage (Shelf)	0	199.8	0	Baggage (Aft)		199.8	
Fuel (At 6 lbs./gal.)	360	118.0	42,480	Fuel (At 6 lbs./gal.)		118.0	
Totals	3,260		353,175	Totals			
$\frac{353{,}175\ lbs.–in.}{3{,}260\ lbs.} = 108.34\ inches$				$\frac{\qquad lbs.–in.}{lbs.} = \qquad inches$			

*When computing baggage moment use the arm for either the Main Baggage Area , Zone A, or Zones A and B as applicable. Refer to the Baggage discussion on page 6-11 for more information. In this example, the weight is evenly distributed over the main baggage area.

NOTE

The basic empty weight used in this example will vary for each airplane. Refer to the Weight and Balance Record, which follows Appendix A of this section.

(Figure 6-13)

In the sample problem, multiplying the weight of a particular item, i.e., pilot, passengers, baggage and fuel, times its arm, computes the moment for that item. The moments and weight are then summed with the basic empty weight and the empty moment of the airplane. In the example, these totals are 3,260 pounds and 353,175 moments. The loaded center of gravity of 108.34 inches is then determined by dividing the total moments by the gross weight.

The multiplying graphs, which begin on page 6-17, can be used to determine the moments for each weight location. The answer is not as accurate as doing the calculation with a hand-held calculator; however, the margin of error is not significant and within acceptable parameters of safety. The example arrows in the graphs on pages 6-17 and 6-18 use the data from the sample problem in (Figure 6-13).

When using the multiplying graphs, it is more convenient to divide the moments on the Y or vertical axis by 1000. For example, 70,000 lbs.-in. is read as 70.0 (x 1000) lbs.-in. Once all the calculations are made, the answer can then be multiplied by 1000. The numbers shown in (Figure 6-14) are moment values obtained by reading directly from the graphs and are expressed as 1000 lbs.-in. It should be noted that there is a nominal difference in center of gravity location between the two procedures.

GRAPHICAL METHOD

SAMPLE PROBLEM GRAPHICAL METHOD (Using moments obtained from the Graphs)*		
ITEM	WT. (Lbs.)	MOMENTS (1000 lbs.-in.)
Basic Empty Wt.	2,295	235.8 (Figure 6-8)
Front Seat Wts.	380	42.0* (Figure 6-15)
Rear Seats Wts.	175	25.0* (Figure 6-17)
Baggage (Main)	50	8.3* (Figure 6-19)
Baggage (Shelf)	0	0.0* (Figure 6-19)
Fuel (At 6 lbs./gal.)	360	42.0* (Figure 6-18)
Totals	3,260	353.1 x 1000 = 353,100

$$\frac{353{,}100\ lbs.\text{–}in,}{3{,}260\,lbs.} = 108.31\ inches$$

(Figure 6-14)

WEIGHT AND BALANCE LIMITATIONS

As its name suggests, weight and balance limitations have two components, a weight limitation and a balance or center of gravity limitation. The maximum gross weight of the airplane is 3400 pounds. This is the first limitation that must be considered in weight and balance preflight planning. If the gross weight is more than 3,400 lbs., then fuel, baggage, and/or passenger weight must be reduced. Once the gross weight is at or below 3400 pounds, consideration is then made for distribution of the weight.

The objective in dealing with the balance limitation is to ensure that the center of gravity is within prescribed ranges at the specified gross weight. The center of gravity range is referred to as the "envelope." The Center of Gravity Envelope graph on page 6-19 shows the envelope for the Columbia 300 (LC40-550FG). Using data from the sample problem in (Figure 6-14), a CG of 108.31 inches at 3,260 lbs. gross weight indicates the airplane, as loaded, is within the envelope.

If the center of gravity is outside the envelope, the airplane is not safe to fly. If the range is exceeded to the left of the envelope, then the airplane is nose heavy and weight must be redistributed with more to the aft position. Conversely, if the range is exceeded to the right of the envelope, then the airplane is tail heavy and weight must be redistributed with more to the forward position. Notice that the range of the envelope decreases as weight increases. At 3400 lbs. maximum gross weight, the range of the envelope is 107 inches to 110 inches, a range of three inches. At 2500 lb. gross weight, the range increases to about seven inches. From this example, it can be seen that as gross weight is decreased, the forward CG range increases.

OTHER WEIGHT LIMITATIONS

TYPE OF WEIGHT LIMITATION	FORWARD DATUM POINT AND WEIGHT	AFT DATUM POINT AND WEIGHT	VARIATION
Minimum Flight Weight	103 inches and 2240 lbs.	110 inches and 2500 lbs.	Straight Line
Maximum Zero Fuel Weight	103 inches and 2725 lbs.	110 inches and 3228 lbs.	Straight Line

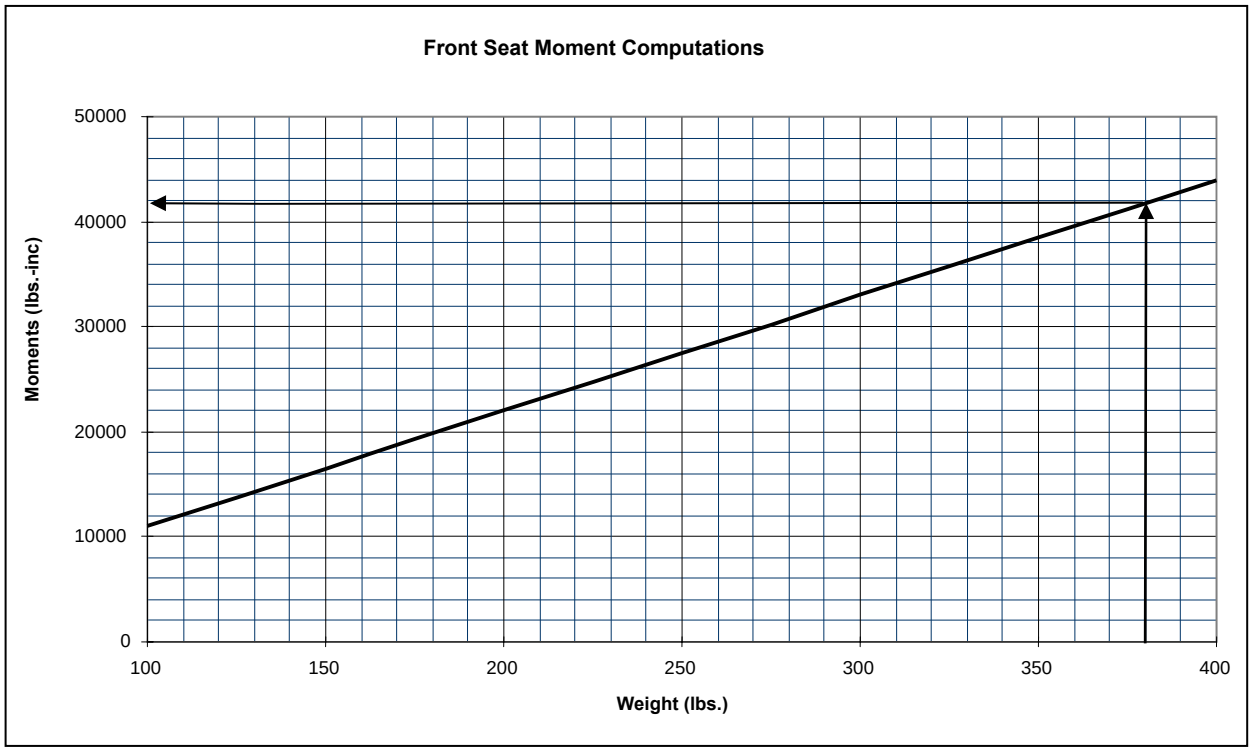
Reference Datum: The reference datum is located at the tip of the propeller spinner. As distance from the datum increases, there is an increase in weight for each of the two limitation categories. The variation is linear or straight line from the fore to the aft positions.

(Figure 6-15)

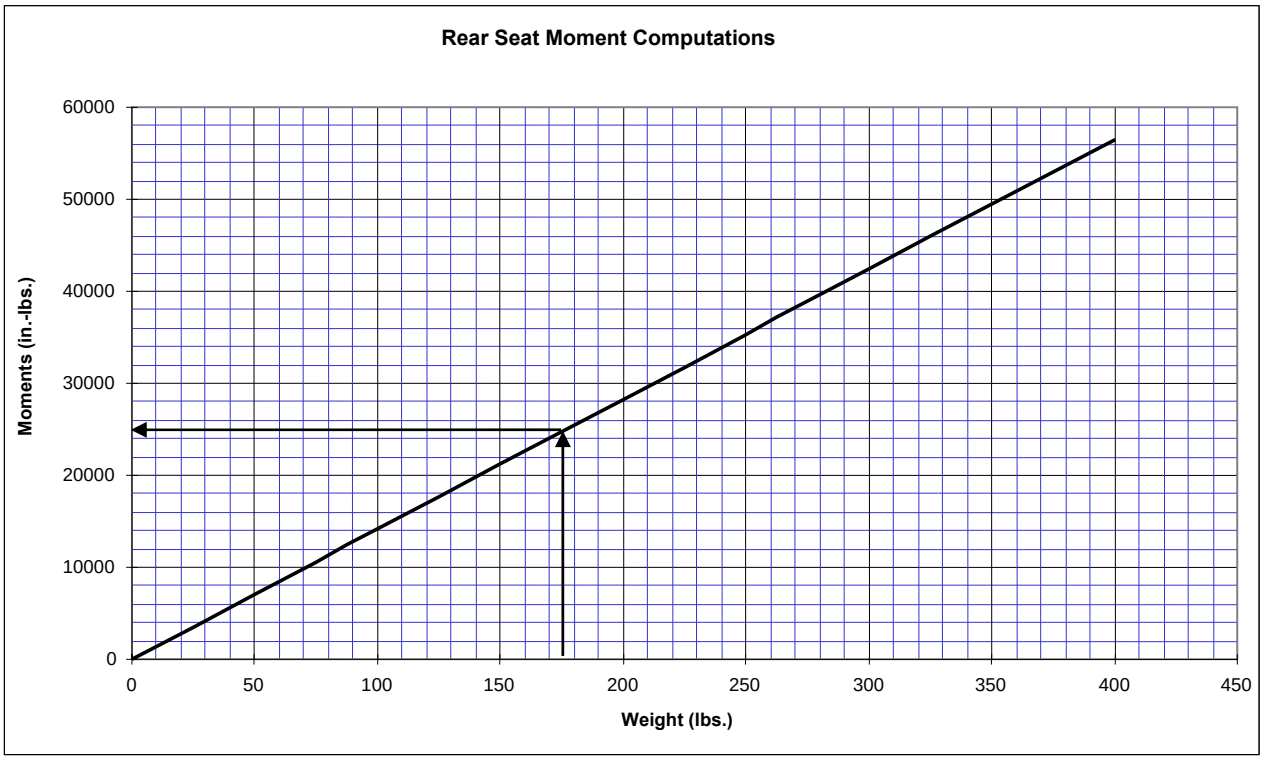
MAXIMUM EMPTY WEIGHT

The maximum empty weight of the Columbia 300 (LC40-550FG) is 2568 pounds. The FAA requires the determination of this weight for FAA certification. For airplanes certified in the IFR utility category, a passenger weight of 190 pounds for each seat plus the fuel weight for 45 minutes of flight are used for this computation. This equates to 72 pounds of fuel and 760 pounds of passenger weight for a total of 832 pounds. For the purpose of this discussion, the 832 pounds is referred to as the minimum useful load. Subtracting the minimum useful load from the maximum gross weight of 3400 pounds produces the maximum empty weight of 2568 pounds.

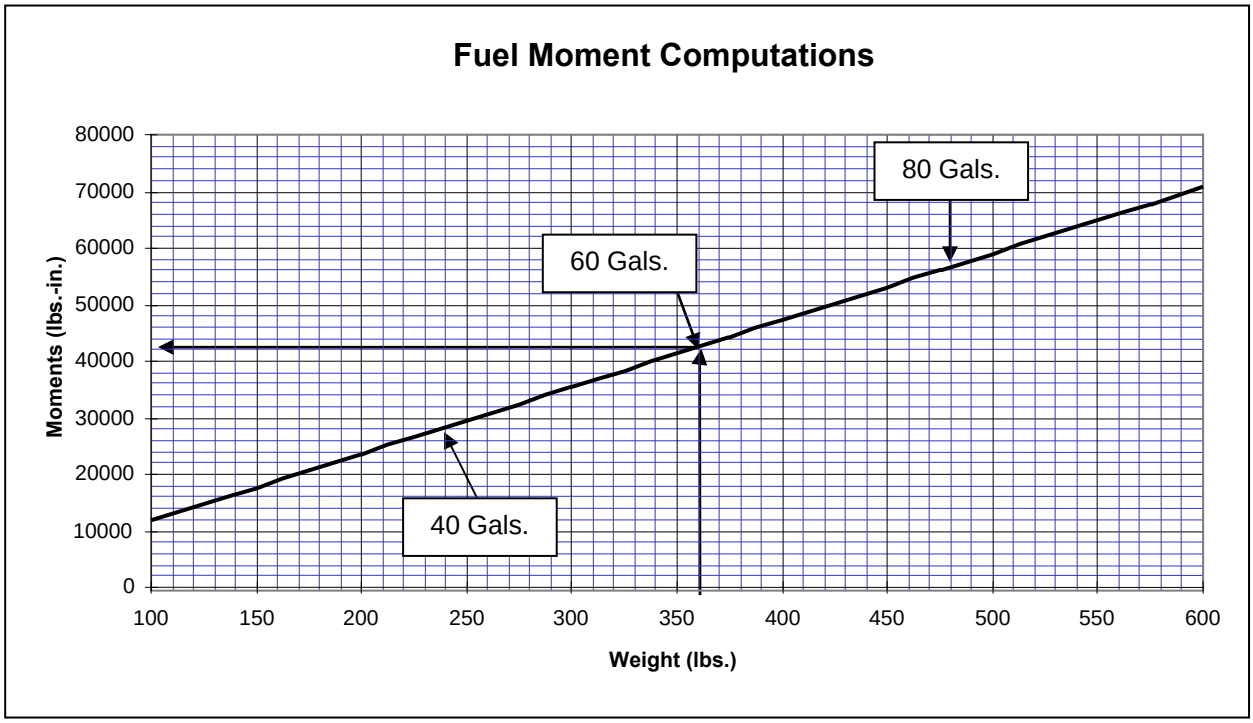
The maximum empty weight is not an abstract concept as it has practical applications. For example, assuming an empty weight of 2200 pounds, the 368 pound difference between the empty weight and the maximum empty weight defines the maximum additional weight of optional equipment that can be added to the airplane.



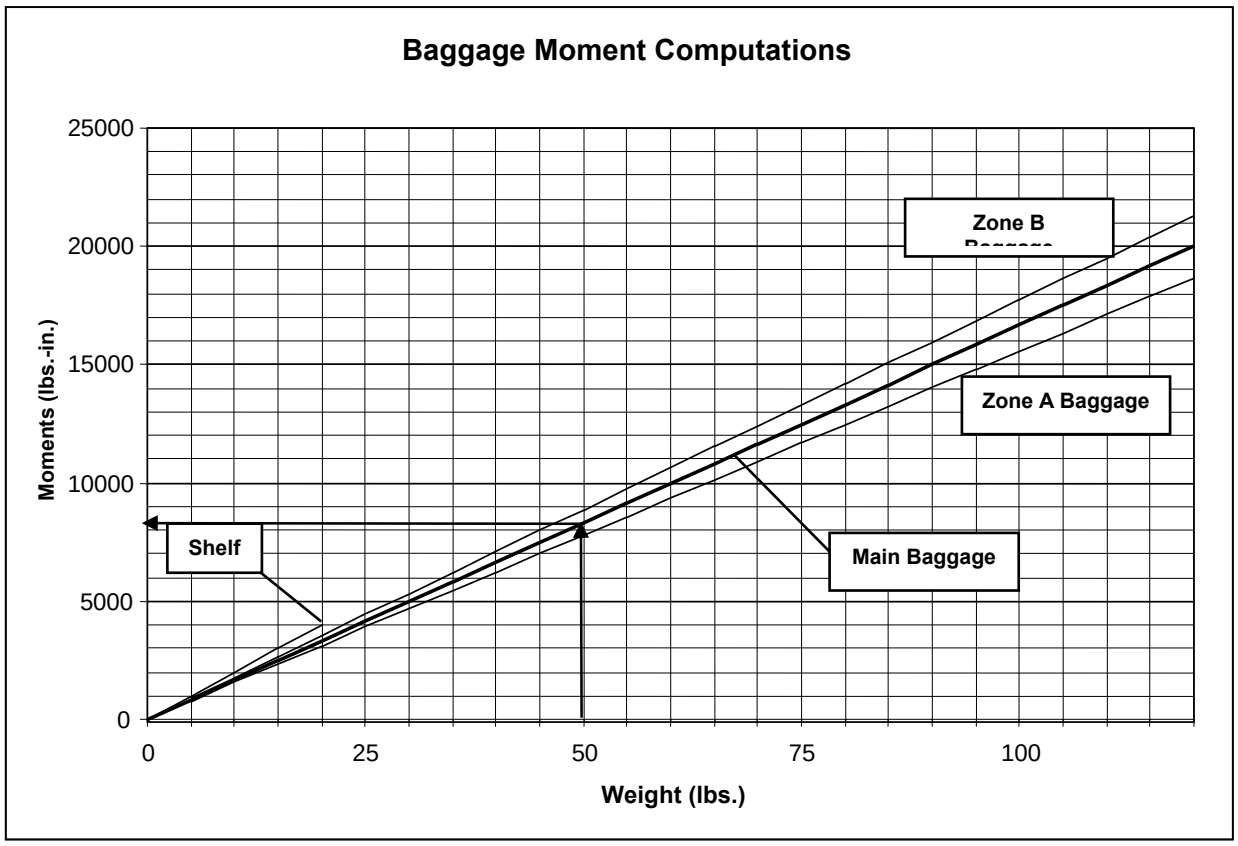
(Figure 6-16)



(Figure 6-17)

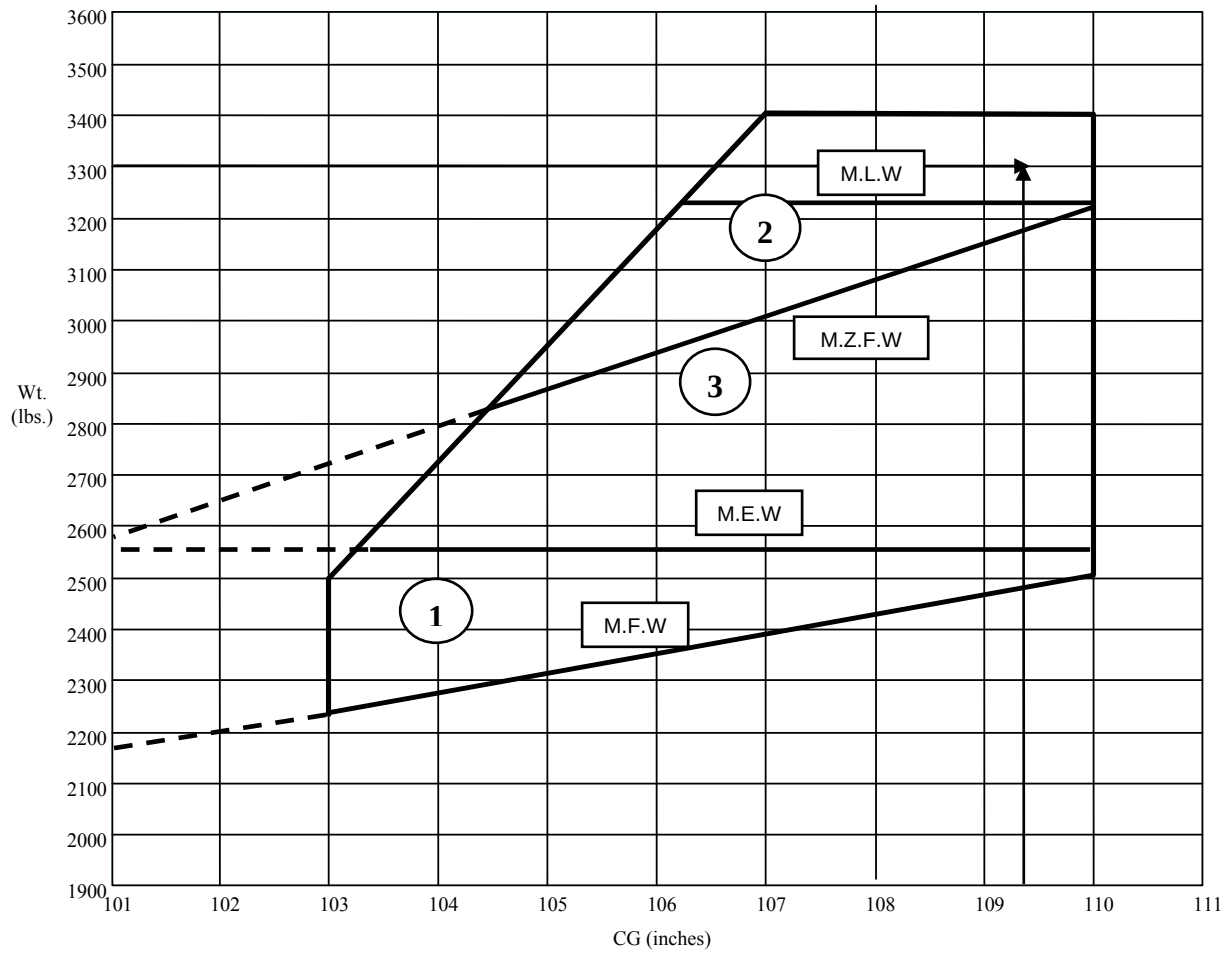


(Figure 6-18)



(Figure 6-19)

COLUMBIA 300 (LC40-550FG) WEIGHT AND BALANCE ENVELOPE



(Figure 6-20)

1. Airplane basic empty weight must be below Maximum Empty Weight (M.E.W.) and above Minimum Flight Weight (M.F.W.).
2. Weight must be below Maximum Landing Weight (M.L.W.) for landing. (If overweight landing occurs, see maintenance manual for required inspection prior to further flight.)
3. Weight and Center of Gravity (CG) without fuel must be below the Maximum Zero Fuel Weight (M.Z.F.W.) line.
4. See Section 2 of the AFM/POH for a listing of weight limitations.

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EQUIPMENT FOR TYPES OF OPERATION

Install code - The following pages contain a listing of equipment that can be installed in the airplane; this is indicated in the Install Code column by the letters B and O. The meaning of each letter code follows.

- **B (Basic Equipment)** - The equipment is installed in all airplanes.
- **O (Optional Equipment)** – This equipment can be installed at the factory at the option of the purchaser.

Chapter Numbers – The chapter numbers listed in the equipment list correspond to the maintenance manual chapter where information regarding the maintenance of the part can be found.

Flight Operation Requirements – There is certain minimum equipment for IFR and night operations. Some equipment is required for all flight operations, while other items are optional. Columns five through eight, under the subheading *Flight Operation Requirements*, identifies which equipment must be installed and functioning for the various flight conditions.

Headsets - Use of the communications equipment requires a headset with a boom mike. Headsets are optional items and not provided by the manufacturer since personal preference is a significant issue. The pilot should add the actual weight of the headset to his or her weight and, when applicable, to each passenger's weight for weight and balance calculations.

EQUIPMENT FOR TYPES OF OPERATION LIST

Lancair Columbia 300

All – Required for all flight operations	**IFR** – Required for IFR flight operations	A shaded box in one of the four Flight Operation Requirements columns indicates the requirement for that item.
Night – Required for night flight operations	**Opt.** – Optional, not required for flight operations	

Item No.	Drawing ref. number	Install Code	Item	Flight Operation Requirements			
				All	**Night**	**IFR**	**Opt.**
CHAPTERS 21-24							
21-01	LA53210003	B	Front Seat Eyeball Vents				
21-02	LA53210003	B	Rear Seat Eyeball vents				
21-03	LA53213000	B	ECS Control Panel				

EQUIPMENT FOR TYPES OF OPERATION LIST

Lancair Columbia 300

All – Required for all flight operations	**IFR** – Required for IFR flight operations	A shaded box in one of the four Flight Operation Requirements columns indicates the requirement for that item.
Night – Required for night flight operations	**Opt.** – Optional, not required for flight operations	

Item No.	Drawing ref. number	Install Code	Item	Flight Operation Requirements			
				All	**Night**	**IFR**	**Opt.**
21-04	LA53210018	B	ECS Cabin Fan				
21-05	LA53216000	B	ECS Heat Box				
21-06	LA71849204	B	ECS Heat Exchanger				
21-07	LA53216000	B	ECS Servomotor				
23-01	LA52275109	B	Static Wicks Ailerons/Wings (4)				
23-02	LA55273000	B	Static Wicks Elevator/Horizontal Stabilizer (4)				
23-03	LA53550000	B	Static Wick Rudder (1)				
23-05	LA53344300	B	SL15-MS Audio Panel			See [1]	See [1]
24-01	LA71840000	B	Alternator 60 amp (14 Volts)				
24-02	LA53241000	B	Battery 14 Volt-25 Amp-hour				
24-03	LA53254272	B	Standby Battery				
24-04	LA53240000	B	Voltage Regulator				
24-05	LA53241000	B	Battery Box				
24-06	LA53516000	O	Ground Power Plug Relay				
24-07	LA53516000	O	Ground Power Plug Socket				
24-08	LA53516000	O	Ground Power Plug Wiring				
CHAPTER 25							
25-01	LA53342100	B	Artex ELT-200 Emergency Locator Transmitter Unit				

1 The SL15 MS has a fail-safe feature, which permits communications on the **No. 1 COMM only**. While, technically speaking, there is no requirement for an audio panel for IFR operations, the pilot should be aware that, without an audio amplifier, it is not possible to identify a navigational stations, use the ICS, or communicate on a radio other than the No.1 position.

EQUIPMENT FOR TYPES OF OPERATION LIST

Lancair Columbia 300

All – Required for all flight operations	**IFR** – Required for IFR flight operations	A shaded box in one of the four Flight Operation Requirements columns indicates the requirement for that item.
Night – Required for night flight operations	**Opt.** – Optional, not required for flight operations	

Item No.	Drawing ref. number	Install Code	Item	Flight Operation Requirements			
				All	**Night**	**IFR**	**Opt.**
25-03	LA53342000	B	ELT Antenna	■			
25-04	LA53310000	B	Annunciator Panel	■			
25-05	LA53514017	B	Circuit Breaker Panel	■			
25-06	LA53311200	B	Rocker Switch Panel	■			
25-07	LA53311300	B	Master/Ignition Switch Panel	■			
25-08	LA53311800	B	Trim Panel	■			
25-09	LA53311100	B	Flap Panel	■			
25-10	LA53311600	B	Light Dimmer Switch Panel				■
25-11	LA53250000	B	Pilot's Adjustable Seat	■			
25-12	LA53250000	B	Copilot's Adjustable Seat	■			
25-13	LA53252500	B	Rear Seat Cushion	■			
25-14	LA53252500	B	Rear Seatback Cushion	■			
25-15	LA53253000	B	Pilot's and Copilot's Three Point Restraint (Each)	■			
25-16	LA53253200	B	Rear Seat Passengers' Three Point Restraint (Each)	■			
25-17	LA53255000	B	Baggage Tie Downs and Restraining Net	See [2]			See [2]
25-18	RA 050001	B	POH and FAA AFM (Stowed in Copilot's Seatback)	■			
25-19	LA53311400	B	Aural Warning System	■			
CHAPTERS 26-31							
26-01	LA53254800	B	Fire Extinguisher Unit	■			
26-02	LA53254800	B	Fire Extinguisher Mounting Bracket	■			
27-01	LA53271001	B	Pilot's Control Stick	■			

2 Baggage tie downs and a restraining net are required if baggage is carried in the baggage compartment.

EQUIPMENT FOR TYPES OF OPERATION LIST

Lancair Columbia 300

All – Required for all flight operations

IFR – Required for IFR flight operations

A shaded box in one of the four Flight Operation Requirements columns indicates the requirement for that item.

Night – Required for night flight operations

Opt. – Optional, not required for flight operations

Item No.	Drawing ref. number	Install Code	Item	Flight Operation Requirements			
				All	**Night**	**IFR**	**Opt.**
27-02	LA53274001	B	Pilot's Rudder Pedals (Each)				
27-03	LA53271002	B	Copilot's Control Stick	See [3]			
27-04	LA53274001	B	Copilot's Rudder Pedals (Each)	See [3]			
31-01	LA53311500	B	Voltmeter/Clock/Outside Air Temperature (OAT)				
31-02	LA53311500	B	Flight Hour Meter				
31-03	LA57314000	B	OAT Probe				
CHAPTER 32							
32-01	LA53321100	B	Main Wheel, Brake and Tire 15x6.00-6 (6-Ply)/Side				
32-02	LA53322101 LA53322105	B	Main Gear Fairings (Each)				
32-03	LA53322109 LA53322113	B	Main Wheel Fairings (Each)				
32-04	LA53321123	B	Main Wheel Fairings Mounting Plate (Each)				
32-05	LA 53321127	B	Tab, Front Wheel Fairing				
32-06	LA 53321129	B	Tab Rear Wheel Fairing				
32-07	LA71324001	B	Nose Strut Fairing				
32-08	LA71324001	B	Nose Wheel Fairing				
32-09	LA71323000	B	Nose Gear Strut				
32-10	LA71322000	B	Nose Wheel, Tire and Tube 5.00-5				

3 The right side controls may be removed provided permanent-type covers are placed over **all** openings from which the control were removed and the procedure is approved and documented in the airframe logbooks by an appropriately certificated A & P mechanic.

EQUIPMENT FOR TYPES OF OPERATION LIST

Lancair Columbia 300

All – Required for all flight operations	**IFR** – Required for IFR flight operations	A shaded box in one of the four Flight Operation Requirements columns indicates the requirement for that item.
Night – Required for night flight operations	**Opt.** – Optional, not required for flight operations	

Item No.	Drawing ref. number	Install Code	Item	Flight Operation Requirements			
				All	**Night**	**IFR**	**Opt.**
CHAPTER 33							
33-01	LA53311600	B	Flip Lights				
33-02	LA53570005	B	Step Lights				
33-03	LA53311600	B	Overhead Reading Lights				
33-04	LA57332000	B	Strobe Lights/ Position Lights				
33-05	LA57331000	B	Landing Light		See [4]		
33-06	LA57331007	B	Taxi Light				
CHAPTER 34							
34-01	LA53344600	B	GX50 GPS			See [5]	See [5]
34-02	LA53342000	B	GPS Antenna			See [6]	See [6]
34-03	LA57317000	B	Marker Beacon Antenna			See [6]	See [6]
34-04	LA53240000	B	SD 120 Blind Encoder/Digitizer	See [7]	See [7]	See [7]	See [7]
34-05	LA53312000	B	SL30 NAV/COMM			See [5]	See [5]
34-06	LA53342000	B	COMM 1 Antenna			See [5]	See [5]
34-07	LA53342000	B	COMM 2 Antenna			See [5]	See [5]
34-08	LA53342000	B	NAV Antenna			See [5]	See [5]

4 A landing light is required if the airplane is used to carry passengers for hire.

5 Both the GPS and the SL30 NAV/COMM are connected to the standby battery system, which is the basis for IFR certification. Accordingly, the antennas for the SL30 and the NAV/COMM unit must be installed and operational for IFR operations. In addition, if a GPS approach or operations will be used during IFR operation, then the GX50 system, including antenna, must be installed and operational.

6 If an ILS approach will be used during IFR operations, then the SL15 audio panel and remote marker beacon lights must be operative.

7 While a transponder, its related encoder, and two-way radio communications are not required for IFR operations in uncontrolled airspace, it is generally impracticable to conduct VFR and IFR flight operations in the 48 contiguous states without this installed equipment.

EQUIPMENT FOR TYPES OF OPERATION LIST

Lancair Columbia 300

All – Required for all flight operations

IFR – Required for IFR flight operations

A shaded box in one of the four Flight Operation Requirements columns indicates the requirement for that item.

Night – Required for night flight operations

Opt. – Optional, not required for flight operations

Item No.	Drawing ref. number	Install Code	Item	Flight Operation Requirements			
				All	**Night**	**IFR**	**Opt.**
34-09	LA53311400	B	MD 200-306 Navigation Indicators				
34-10	LA53311400	B	UPSAT 14H Annunciator Control Unit (ACU)				
34-11	LA53344500	B	Transponder Unit	See [7]	See [7]	See [7]	See [7]
34-12	LA53344500	B	Transponder Antenna	See [7]	See [7]	See [7]	See [7]
34-13	LA53342209	B	KI 525A HSI Indicator				
34-14	LA53342201	B	KG 102 Remote Gyro				
34-15	LA53342207	B	KMT 112 Flux Valve				
34-16	LA53342205	B	Panel Mounted KA 51B Slaving Control				
34-17	LA53342500	O	Avidyne FlightMonitor (Moving Map Display)				
34-18	LA53311400	O	Shadin Mini-flo Panel Unit				
34-19	LA53311400	O	Shadin Flow Transducer (Pinwheel)				
34-20	761017	O	S-Tec 360 Autopilot Altitude Preselect				
34-21	LA53312000	B	S-Tec 55 Autopilot Flight Guidance Computer				
34-22	76997	B	Roll Servo				
34-23	761017	B	Pitch Servo				
34-24	761017	B	Annunciator Unit				
34-25	LA53240000	B	Pressure Transducer				
34-26	10134	B	Trim Adapter				
34-27	LA53311400	B	KI 256 Flight Director System				
34-28	LA53311400	B	Airspeed Indicator				
34-29	LA53311400	B	KI 256 Artificial Horizon				
34-30	LA53311400	B	Altimeter				
34-31	LA53311400	B	Turn Coordinator				
34-32	LA53311400	B	Vertical Speed Indicator				

EQUIPMENT FOR TYPES OF OPERATION LIST

Lancair Columbia 300

All – Required for all flight operations	**IFR** – Required for IFR flight operations	A shaded box in one of the four Flight Operation Requirements columns indicates the requirement for that item.
Night – Required for night flight operations	**Opt.** – Optional, not required for flight operations	

Item No.	Drawing ref. number	Install Code	Item	Flight Operation Requirements			
				All	**Night**	**IFR**	**Opt.**
34-33	LA53254000	B	Magnetic Compass	■			
34-34	LA53311500	B	Fuel Quantity Indicator Gauge	■			
34-35	LA53311500	B	Tachometer	■			
34-36	LA57313000	B	Stall Warning Switch	■			
34-37	LA57313000	B	Stall Warning Horn	■			
34-38	LA53274300	B	Rudder Limiter assembly	■			
34-39	LA57312002	B	Heated Pitot Tube	■		■	
34-40	N/A	O	Precise Flight Speed Brake 2000 System – Wing Units (Each)				■
34-41	N/A	O	Precise Flight Speed Brake 2000 System – Computer				■
34-42	LA53343903	O	Apollo MX20 MFD				■
34-43	N/A	O	S-Tec 429 Global Positioning System Steering Remote Switch				■
34-44	N/A	O	S-Tec 429 Global Positioning System Steering Unit				■
CHAPTER 37							
37-01	LA71842000	B	Vacuum Pumps (Each)			See [8]	
37-02	LA71844100	B	Vacuum Filter			■	
37-03	LA53260000	B	Vacuum Regulator Valve			■	
37-04	LA53260000	B	Manifold Shuttle Valve			■	
CHAPTERS 52-77							
53-01	LA53325100	B	Cabin Entry Steps (Each) [9]				

8 Both vacuum pumps must be operational for IFR operations.

9 The step is included in the basic package; however, some owners/operators elect to not have it installed since it lowers cruise speed slightly.

EQUIPMENT FOR TYPES OF OPERATION LIST

Lancair Columbia 300

All – Required for all flight operations

IFR – Required for IFR flight operations

A shaded box in one of the four Flight Operation Requirements columns indicates the requirement for that item.

Night – Required for night flight operations

Opt. – Optional, not required for flight operations

Item No.	Drawing ref. number	Install Code	Item	Flight Operation Requirements			
				All	**Night**	**IFR**	**Opt.**
61-01	LA71820000	B	Propeller	■			
61-02	LA71820000	B	Propeller Spinner	■			
61-03	LA71820000	B	Propeller Governor	■			
71-01	LA71840000	B	Starter Motor, TCM Energizer	■			
71-02	LA71844100	B	Engine Intake Filter	■			
72-01	LA71000000	B	IO-550N TCM Engine Complete	■			
77-01	LA53311500	B	Vacuum Gauge/Ammeter			■	
77-02	LA53311500	B	Oil Pressure/Temperature Gauge	■			
77-03	LA53311500	B	Fuel Flow/Manifold Pressure Gauge		■		■
77-04	LA53311500	B	Cylinder Head/Exhaust Gas Temperature Gauge				■
77-05	LA53343201	O	JPI EDM-700 Digital Engine Scanner				■

INSTALLED EQUIPMENT LIST (IEL)

Equipment List N65099 ─ S/N 40075 ─ Date A/C was weighed ─ June 11, 2003

Item No	Drawing Reference Number	Installed	Item	Weight	Arm
21-01	LA53210003	✓	Front Seat Eyeball Vents	2.07	79.0
21-02	LA53210003	✓	Rear Seat Eyeball Vents	2.07	130.4
21-03	LA53213000	✓	ECS Control Panel	0.42	79.0
21-04	LA53210018	✓	ECS Cabin Fan	2.05	63.43
21-05	LA53216000	✓	ECS Heat Box	2.44	63.43
21-06	LA71849204	✓	ECS Heat Exchanger	1.6	56.6
21-07	LA53216000	✓	ECS Servomotor	0.26	63.43
23-01	LA52275109	✓	Static Wicks Ailerons/Wings (4)	0.07	140
23-02	LA55273000	✓	Static Wicks Elevator/Horizontal Stabilizer (4)	0.07	279.4
23-03	LA53550000	✓	Static Wick Rudder (1)	.018	301.3
23-05	LA53344300	✓	SL15-MS Audio Panel	0.8	79
24-01	LA71840000	✓	Alternator 60 amp (14 Volts)	12.8	28.3
24-02	LA53241000	✓	Battery 14 Volt-25 Amp-hour	30.0	63.0
24-03	LA53254272	✓	Standby Battery	1.83	70.3
24-04	LA53240000	✓	Voltage Regulator	.3.0	70
24-05	LA53241000	✓	Battery Box	2.17	63.0
24-06	LA53516000	✓	Ground Power Plug Relay	0.9	55.0
24-07	LA53516000	✓	Ground Power Plug Socket	0.8	153.0
24-08	LA53516000	✓	Ground Power Plug Wiring	3.9	104.0
25-01	LA53342100	✓	Artex ELT-200 Emergency Locator Transmitter Unit	2.47	215
25-03	LA53342000	✓	ELT Antenna	0.11	217.1
25-04	LA53310000	✓	Annunciator Panel	0.43	79.0
25-05	LA53514017	✓	Circuit Breaker Panel	3.9	89.5
25-06	LA53311200	✓	Rocker Switch Panel	0.47	79.0
25-07	LA53311300	✓	Master/Ignition Switch Panel	0.67	79.0
25-08	LA53311800	✓	Trim Panel	0.46	79.0
25-09	LA53311100	✓	Flap Panel	0.47	79.0

INSTALLED EQUIPMENT LIST (IEL)

Equipment List N65099 ─ S/N 40075 ─ Date A/C was weighed ─ June 11, 2003

Item No	Drawing Reference Number	Installed	Item	Weight	Arm
25-10	LA53311600	✓	Light Dimmer Switch Panel	0.14	110.36
25-11	LA53250000	✓	Pilot's Adjustable Seat	24.0	106.6
25-12	LA53250000	✓	Copilot's Adjustable Seat	24.0	106.6
25-13	LA53252500	✓	Rear Seat Cushion	5.7	134.9
25-14	LA53252500	✓	Rear Seatback Cushion	9.2	150.2
25-15	LA53253000	✓	Pilot's and Copilot's Three Point Restraint (Each)	1.82	128.5
25-16	LA53253200	✓	Rear Seat Passengers' Three Point Restraint (Each)	1.76	145.7
25-17	LA53255000	✓	Baggage Tie Downs and Restraining Net	1.51	175.0
25-18	RA050001	✓	POH and FAA AFM (Stowed in Copilot's Seatback)	3.5	128.5
25-19	LA53311400	✓	Aural Warning Remote Unit	0.6	79.0
26-01	LA53254800	✓	Fire Extinguisher Unit	3.56	88.0
26-02	LA53254800	✓	Fire Extinguisher Mounting Bracket	0.32	89.8
27-01	LA53271001	✓	Pilot's Control Stick	1.59	91.4
27-02	LA53274001	✓	Pilot's Rudder Pedals (Each)	1.0	71.6
27-03	LA53271002	✓	Copilot's Control Stick	1.59	91.4
27-04	LA53274001	✓	Copilot's Rudder Pedals (Each)	1.0	71.6
31-01	LA53311500	✓	Voltmeter/Clock/Outside Air Temperature (OAT)	0.32	78.0
31-02	LA53311500	✓	Flight Hour Meter	0.13	78.0
31-03	LA57314000	✓	OAT Probe	0.03	79.0
32-01	LA53321100	✓	Main Wheel, Brake and Tire 15x6.00-6 (6-Ply)/Side	18.4	122.1
32-02	LA53322101 LA53322105	✓	Main Gear Fairings (Each)	2.4	131.7
32-03	LA53322109 LA53322113	✓	Main Wheel Fairings (Each)	3.9	122.1
32-04	LA53321123	✓	Main Wheel Fairings Mounting Plate (Each)	0.4	122.1
32-05	LA53321127	✓	Tab, Front Wheel Fairing	0.1	112.8
32-06	LA53321129	✓	Tab, Rear Wheel Fairing	0.1	130.6

INSTALLED EQUIPMENT LIST (IEL)

Equipment List N65099 – S/N 40075 – Date A/C was weighed – June 11, 2003

Item No	Drawing Reference Number	Installed	Item	Weight	Arm
32-07	LA71324001	✓	Nose Strut Fairing	0.76	40.89
32-08	LA71324001	✓	Nose Wheel Fairing	1.89	40.89
32-09	LA71323000	✓	Nose Gear Strut	12.2	40.89
32-10	LA71322000	✓	Nose Wheel, Tire and Tube 5.00-5	14.8	40.89
33-01	LA53311600	✓	Flip Lights	.074	116.0
33-02	LA53570005	✓	Step Lights	0.05	150.0
33-03	LA53311600	✓	Overhead Reading Lights	0.16	102.62
33-04	LA57332000	✓	Strobe Lights/ Position/	0.54	135.9
33-05	LA57331000	✓	Landing Light	0.29	102.4
33-06	LA57331007	✓	Taxi Light	0.29	102.4
34-01	LA53344600	✓	GX50 GPS	2.6	79.0
34-02	LA53342000	✓	GPS Antenna	0.24	226.4
34-03	LA57317000	✓	Marker Beacon Antenna	0.45	120.5
34-04	LA53240000	✓	SD 120 Blind Encoder/Digitizer	0.63	79.0
34-05	LA53312000	✓	SL30 NAV/COMM (2)	2.25	79.0
34-06	LA53342000	✓	COMM 1 Antenna	0.56	164.0
34-07	LA53342000	✓	COMM 2 Antenna	0.56	199.0
34-08	LA53342000	✓	NAV Antenna	0.41	276.5
34-09	LA53311400	✓	MD 200-306 Navigation Indicators	1.2	75.0
34-10	LA53311400	✓	UPSAT 14H Annunciator Control Unit (ACU)	0.5	75.0
34-11	LA53344500	✓	Transponder Unit	2.27	75
34-12	LA53344500	✓	Transponder Antenna	0.3	111.5
34-13	LA53342209	✓	KI 525A HSI Indicator	3.94	75.0
34-14	LA53342201	✓	KG 102 Remote Gyro	4.3	75.0
34-15	LA53342207	✓	KMT 112 Flux Valve	0.3	75.0
34-16	LA53342205	✓	Panel Mounted KA 51B Slaving Control	0.2	75.0
34-17	LA53342500		Avidyne FlightMonitor (Moving Map Display)	8.5	78.0

INSTALLED EQUIPMENT LIST (IEL)

Equipment List N65099 ─ S/N 40075 ─ Date A/C was weighed ─ June 11, 2003

Item No	Drawing Reference Number	Installed	Item	Weight	Arm
34-18	LA53311400	✓	Shadin Mini-flo Panel Unit (STC)	1.0	78.0
34-19	LA53311400	✓	Shadin Pinwheel (STC)	1.0	66.5
34-20	761017	✓	S-Tec 360 Autopilot Altitude Preselect (STC)	0.9	78.0
34-21	LA53343900	✓	Apollo MX20 (2)	7.2	77.0
34-22	LA53312000	✓	S-Tec 55 Autopilot Flight Guidance Computer (STC)	2.8	75.0
34-23	76997	✓	Roll Servo	2.9	75.0
34-24	761017	✓	Pitch Servo	2.9	75.0
34-25	761017	✓	Annunciator Unit	.75	75.0
34-26	LA53240000	✓	Pressure Transducer	0.2	75.0
34-27	10134	✓	Trim Adapter	0.9	75.0
34-28	LA53311400	✓	KI 256 Flight Director System	3.3	78.0
34-29	LA53311400	✓	Airspeed Indicator	0.77	78.0
34-30	LA53311400	✓	KI 256 Artificial Horizon	2.0	75.0
34-31	LA53311400	✓	Altimeter	0.9	75.0
34-32	LA53311400	✓	Turn Coordinator	1.2	78.0
34-33	LA53311400	✓	Vertical Speed Indicator	0.7	78.0
34-34	LA53254000	✓	Magnetic Compass	0.75	76.0
34-35	LA53311500	✓	Fuel Quantity Indicator Gauge	0.76	78.0
34-36	LA53311500	✓	Tachometer	0.76	78.0
34-37	LA57313000	✓	Stall Warning Switch	0.24	99.5
34-38	LA57313000	✓	Stall Warning Horn	0.19	129.74
34-39	LA53274300	✓	Rudder Limiter assembly	1.51	68.5
34-40	LA57312002	✓	Heated Pitot Tube	0.39	117.7
34-41	N/A	✓	Precise Flight SpeedBrake™ 2000 System - Wing Units (Each) STC	4.0	126.0
34-42	N/A	✓	Precise Flight SpeedBrake™ 2000 System – Computer STC	0.5	147.0
34-43	PA53343600	✓	S-Tec 429 Global Positioning System Steering Remote Switch	0.05	82.0
34-44	PA53343600	✓	S-Tec 429 Global Positioning System Steering Unit	0.25	149.0

INSTALLED EQUIPMENT LIST (IEL)

Equipment List N65099 ─ S/N 40075 ─ Date A/C was weighed ─ June 11, 2003

Item No	Drawing Reference Number	Installed	Item	Weight	Arm
35-01	SA01060SE	✓	Semi-Portable Oxygen System (STC)	13.0	133.0
37-01	LA71842000	✓	Vacuum Pumps (Each)	1.91	53.8
37-02	LA71844100	✓	Vacuum Filter	0.43	67.0
37-03	LA53260000	✓	Vacuum Regulator Valve	0.40	62.9
37-04	LA53260000	✓	Manifold Shuttle Valve	0.79	62.9
53-01	LA53325100	✓	Cabin Entry Steps (Each)	2.15	160.2
61-01	LA71820000	✓	Propeller	70.0	15.0
61-02	LA71820000	✓	Propeller Spinner	7.3	14.0
61-03	LA71820000	✓	Propeller Governor	2.80	28.0
71-01	LA71840000	✓	Starter Motor, TCM Energizer	17.75	58.0
71-02	LA71844100	✓	Engine Intake Filter	0.80	28.0
72-01	LA71000000	✓	IO-550N2 TCM Engine Complete	465.0	44.45
77-01	LA53311500	✓	Vacuum Gauge/Ammeter	0.77	78.0
77-02	LA53311500	✓	Oil Pressure/Temperature Gauge	0.76	78.0
77-03	LA53311500	✓	Fuel Flow/Manifold Pressure Gauge	0.79	78.0
77-04	LA53311500		Cylinder Head/Exhaust Gas Temperature Gauge	0.78	78.0
77-05	LA53343800	✓	JPI EDM 700	0.91	78.0

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The use of this page is optional and is provided for listing items that were added to the airplane via a Supplemental Type Certificate (STC) or other FAA approved procedures. This page is included in this section as a convenience to provide consistency in presentation. The page does <u>not</u> replace or amend any required documentation attendant with the after-market installation and/or modification.

TABULATED AFTER-MARKET EQUIPMENT LIST (TAMEL)

Lancair Columbia 300

Item No.	Serial / Part No.	ATA Chapter	Item	Weight (lbs.)	Arm (ins.)
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					

TABULATED AFTER-MARKET EQUIPMENT LIST (TAMEL)

Lancair Columbia 300

Item No.	Serial / Part No.	ATA Chapter	Item	Weight (lbs.)	Arm (ins.)
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					
31.					
32.					
33.					
34.					
35.					
36.					
37.					
38.					
39.					
40.					

WEIGHT & BALANCE RECORD

(Continuing History of Changes in Structure or Equipment Affecting Weight and Balance)

AIRPLANE MODEL: COLUMBIA 300 (LC40-550FG)	SERIAL NUMBER: 40075 Date Airplane Weighed – June 11, 2003 (Initial)	PAGE NO. 1

DATE MOVED	ITEM MOVED		DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT /MOMENT CHANGE						RUNNING TOTALS	
				WEIGHT ADDED			WEIGHT REMOVED				
	IN	OUT		(Lbs.)	(Inches)	(Lbs. – in.)	(Lbs.)	(Inches)	(Lbs. – in.)	(Lbs.)	(Lbs. – in.)
	N/A	N/A	BASIC AIRPLANE AS DELIVERED	N/A	N/A	N/A	N/A	N/A	N/A	2369.33	**245,307.67**

WEIGHT & BALANCE RECORD

(Continuing History of Changes in Structure or Equipment Affecting Weight and Balance)

AIRPLANE MODEL: COLUMBIA 300 (LC40-550FG)	SERIAL NUMBER: 40075 Date Airplane Weighed – June 11, 2003 (Initial)	PAGE NO. 2

DATE MOVED	ITEM MOVED		DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT /MOMENT CHANGE						RUNNING TOTALS	
				WEIGHT ADDED			WEIGHT REMOVED				
	IN	OUT		(Lbs.)	(Inches)	(Lbs. – in.)	(Lbs.)	(Inches)	(Lbs. – in.)	(Lbs.)	(Lbs. – in.)

Section 7
Description of Airplane & Systems

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Section 7
Description of Airplane & Systems

INTRODUCTION

Section 7 provides a basic understanding of the airplane's airframe, powerplant, systems, avionics, and components. The systems include: electrical and lighting system; flight control system; wing flap system; fuel system; braking system; heating and ventilating system; door sealing system; pitot pressure system; static pressure system; stall warning system and the vacuum system. In addition, various non-system components are described. These include: control locks; doors and exits; baggage compartment; seats, seat belts and shoulder harnesses; and the instrument panel.

Terms that are not well known and not contained in the definitions in Section 1 are explained in general terms. The description and discussion on the following pages assume a basic understanding of airplane nomenclature and operations.

AIRFRAME & RELATED ITEMS

The Lancair Columbia 300 (LC40-550FG) is a pre-molded, composite built, semi-monocoque, four seat, single engine, low wing, tricycle design airplane. The airplane is certified in the utility category and is used primarily for transportation and related general aviation uses.

BASIC CONSTRUCTION TECHNIQUES

The construction process used to build the shell or outer surfaces of the fuselage, wing, and most control surfaces involves creating a honeycomb sandwich. The sandwich consists of outer layers of pre-preg fiberglass around a honeycomb interior. The term "pre-preg fiberglass" means the fibrous material is impregnated with catalyzed epoxy resin by the manufacturer. This process ensures consistency in surface thickness and strength. The honeycomb sandwich is assembled in molds of the wing, fuselage, and control surfaces. An air pressure process is used during the heat curing procedure to ensure a tight bond. Other structural components of the airplane, like ribs, bulkheads, and spars, are constructed in the same manner. In areas where added structural strength is needed, such as the wing spars, carbon fibers are added to the honeycomb sandwich.

Fuselage – The fuselage is built in two halves, the left and right sides; each side contains the area from the firewall back to and including the vertical stabilizer. The bulkheads are inserted into the right side of the fuselage through a process known as secondary bonding. The two fuselage halves are bonded together, and the floors are bonded in after fuselage halves are joined. Before the fuselage is assembled into one unit, cables, control actuating systems, and conduits are added because of the ease in access. To prevent damage to the leading edge of the vertical stabilizer, anti-erosion tape may be installed.

Wings and Fuel Tanks – The bottom of the wing is one continuous piece. The spars are placed in the bottom wing and bonded to the bottom inside surface. Next, the ribs are inserted and bonded to the inside surfaces of the bottom wing and to the spars. Finally, after wires, conduits, and control tubes are inserted, the two top wing halves are bonded to the bottom wing and all the spars and ribs. The airplane has integral fuel tanks, commonly referred to as a "wet wing." The ribs, spars, and wing surfaces are the containment walls of the fuel tanks. All interior seams and surfaces within the fuel tanks are sealed with a fuel impervious substance. The wing cuffs (specially shaped pieces of composite material) are bonded to the outboard leading edge of the wing to increase the camber, or curvature, of the airfoil. This improves the slow-flight and stall characteristics of the wing. To prevent damage to the leading edge of the wing, anti-erosion tape may be installed.

Horizontal Stabilizer – The horizontal stabilizer is two separate halves bonded to two horizontal tubes that are bonded to the fuselage. The shear webs and ribs are bonded into the inside surface of the lower skin and the upper skin is then bonded to the lower assembly. To prevent damage to the leading edge of the horizontal stabilizer, anti-erosion tape may be installed.

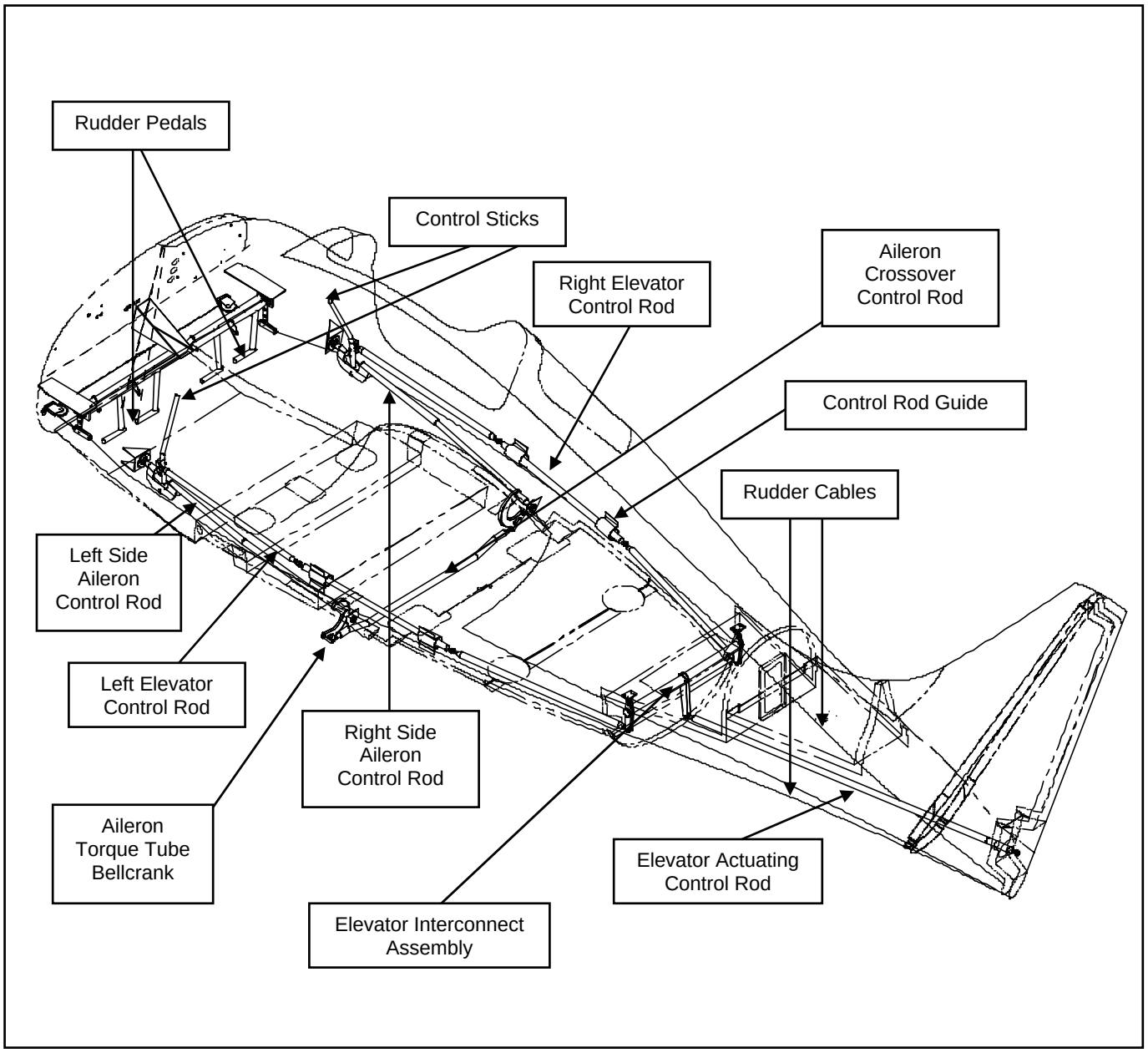
FLIGHT CONTROLS

Ailerons and Elevator – The ailerons and elevator are of one-piece construction with most of the stresses carried by the control surface. The end caps and drive rib that are used to mount the control's actuating hardware provide additional structural support. The aileron and elevator control systems are operated through a series of actuating rods and bellcranks that run between the control surface and the control stick in the cockpit. See (Figure 7 - 1) for an illustration of the flight control systems.

Aileron Servo Tab – The aileron servo tab on the trailing edge of the left aileron assists in movement of the aileron. The servo tab is connected to the aileron in a manner that causes the tab to move in a direction opposite the movement of the aileron. The increased aerodynamic force applied to the tab helps to move the aileron and reduces the level of required force applied to the control stick.

Rudder - The rudder is of one-piece construction with most of the stresses carried by the control surface. The drive rib that is used to mount the control's actuating hardware provides additional structural support. The rudder control system is operated through a series of cables and mechanical linkages that run between the control surface and the rudder pedals in the cockpit. See (Figure 7 - 1).

FLIGHT CONTROL SYSTEM DIAGRAM



(Figure 7 - 1)

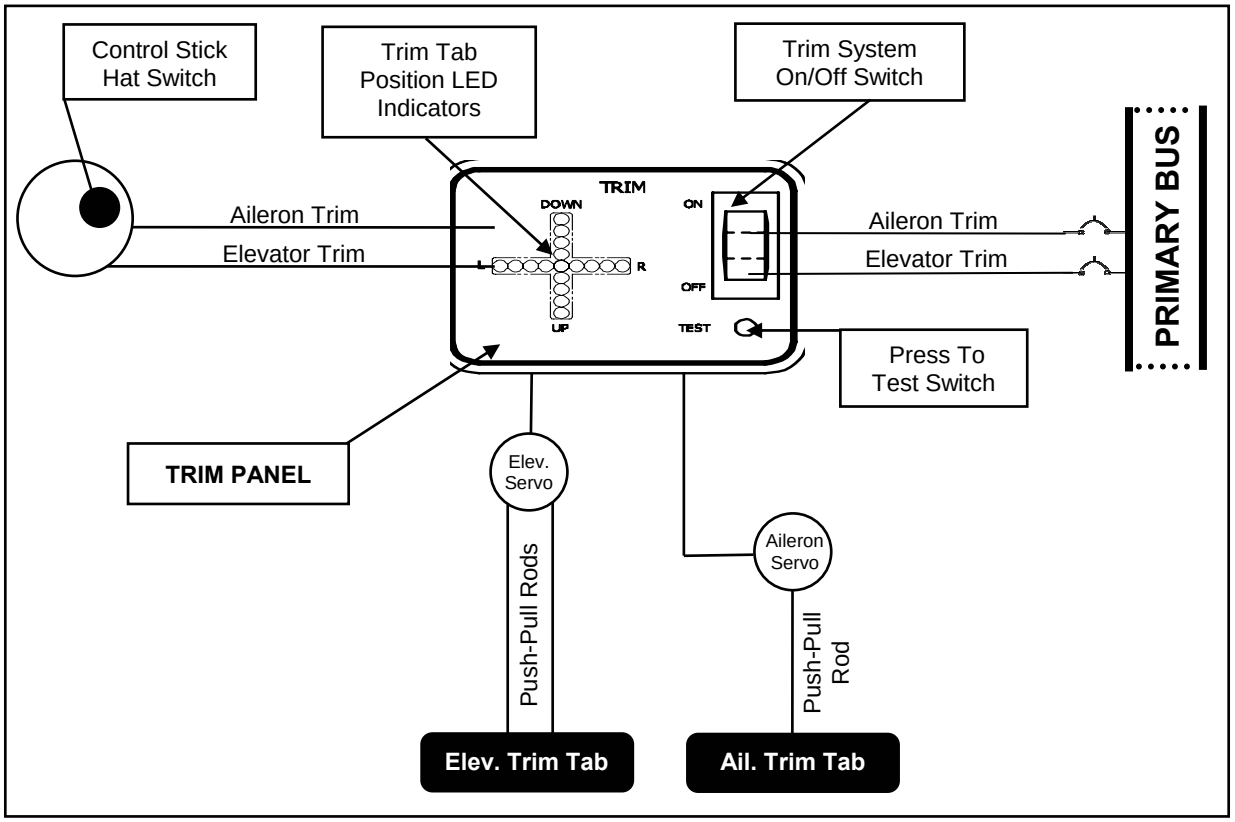
Rudder Limiter – When the system is activated, a restricting device limits the left rudder travel from 17º ± 1º to 11.5º ± 0.5º. The system is engaged when the stall warning is active and the manifold pressure is above 12 in. of Hg. For more information, see the Stall Warning System discussion on page 7-47.

Control Lock – When the airplane is parked or stored, there is a control lock designed to limit movement of the ailerons, elevator, and rudder during high wind conditions. The device attaches to the control stick, the rudder pedals, and a bracket under the pilot's seat, near the crash ax. A red flagged extension arm limits access to the ignition switch until the device is removed.

TRIM SYSTEM

Elevator and Aileron - The airplane has a two axis trimming system. The elevator trim tab is located on the right side of the elevator, and the aileron trim tab is on the right aileron. A hat switch on each control stick electrically controls both tabs, and the trim position is annunciated on the trim panel, located to the right of the rocker switch panel. The trim servos are protected by one-amp circuit breakers. See (Figure 7 - 2) for an illustration of the trim system.

TRIM SYSTEM DIAGRAM



(Figure 7 - 2)

The trim surfaces are moved by push rods connected between each tab and a servomotor. The aileron tab has one actuating rod and the elevator tab has two. The second actuating rod on the elevator is a redundant system and is provided for the more critical tab in the system. The frictional device installed on the aileron tab should never be lubricated.

Hat Switches – The trim tabs are controlled through use of a *Hat Switch* on the top portion of pilot's and copilot's control stick, at the three and nine o'clock positions, respectively. Moving the switch forward will correct a tail heavy condition, and moving it back will correct a nose heavy condition. Moving the hat switch left or right will correct right wing down and left wing heavy conditions, respectively.

Simultaneous Trim Application – If both switches, pilot's and copilot's, are moved in the **same** direction at the same time, the trim will operate in the direction selected. For example, nose down trim is selected on both hat switches. If the switches are simultaneously moved in **opposite** directions, e.g., pilot's is nose down and copilot's is nose up the pilot's selection overrides the copilot's. Finally, if trim is simultaneously selected in **different** directions, e.g., elevator trim is input by one pilot and aileron trim is input by the other, each trim tab will move in the direction selected.

Trim Position Indicator – The trim position is displayed on two light bars using a series of blue LED's and two green light emitting diodes (LED) that are arranged on the trim panel in the shape of a plus sign. The vertical lights indicate the position of the elevator trim and the horizontal lights show the position of the aileron trim. The middle green lights in each bar indicate the approximate neutral position.

The blue lights are sequentially lit and extinguished as the trim tab moves through its range of travel. If the two green LED's in the middle of the "+" are lit and no blue lights are illuminated, both tabs are in the approximate neutral position. The LED's level of brightness is controlled by the position lights switch. When the position lights are on, the trim lights are in the dim mode, and when the position lights are off, the trim lights are in the bright mode.

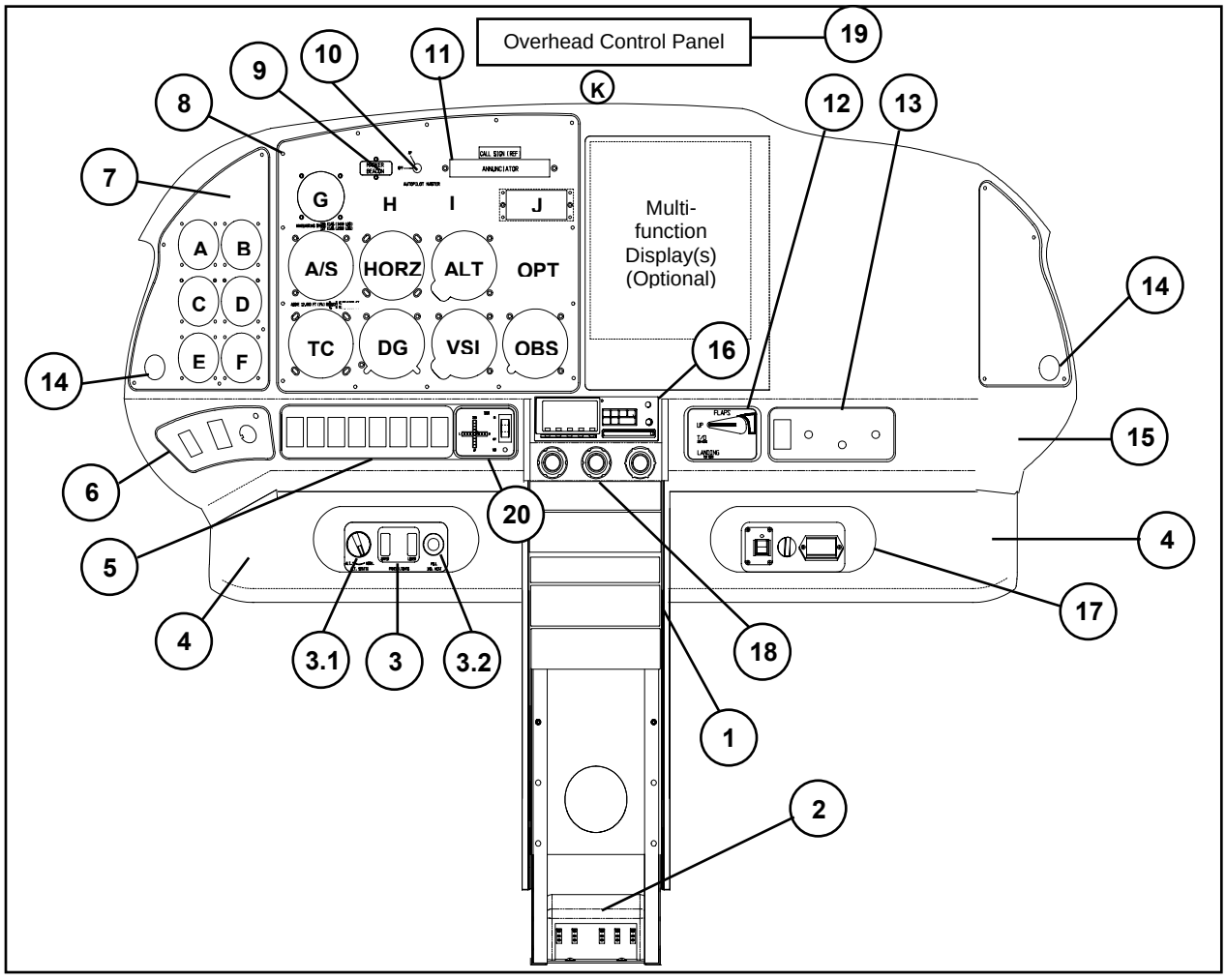
Trim On/Off Switch – The trim system on/off switch on the right side of the panel turns off power on all the trim tabs. This switch is used if a runaway trim condition is encountered. See page 3-18 for an expanded discussion of this issue. The press to test switch is discussed later in this section on page 7-45 under the heading *Trim, Flaps, Fuel Tank Position, and Annunciator Panel (Press to Test)*.

Rudder Trim – The airplane has a manually adjustable tab on the lower portion of the rudder. The tab is adjusted at the factory to produce near neutral rudder pressures at 8,000 feet MSL and 75% power. At other power settings and/or altitudes a slight amount of rudder pressure or aileron trim may be required. The owner or operator of the airplane may wish to adjust this tab to accommodate the most frequently used cruise configuration. The procedures for adjusting the manual tab are contained in Chapter 27 of the *Columbia 300 Airplane Maintenance Manual*.

NOTE

Do not adjust the manual rudder tab by hand since this can produce an uneven deflection or warping of the tab. Refer to the procedures in Chapter 27 of the *Columbia 300 Airplane Maintenance Manual* for adjustment of the manual tab.

INSTRUMENT PANEL AND BASIC COCKPIT LAYOUT DIAGRAM



Instrument Panel and Cockpit

1. Radio Rack Panel Assembly
2. Fuel Selector (On forward part of center armrest)
3. Left dimmer controls backlighting for radios and switches; right dimmer controls engine and flight instrument backlighting
   - 3.1. Alternate Static Air
   - 3.2. Heated Induction Air
4. Left/Right Knee Bolster
5. Rocker Switch Panel - See (Figure 7 - 14)
6. Master Switch Panel (Location of system master switch, avionics master switch, ignition switch, and primer)
7. Engine Instrument Panel
8. Flight Instrument Panel
9. Marker Beacon Lights
10. Autopilot Master/Control Switch
11. Annunciator Panel - See (Figure 7 - 5)
12. Flap Panel – Flap switch and Annunciator
13. Environmental Control System (ECS) Panel
14. Fresh Air Vents
15. Lower Instrument Panel
16. GPS– See page 53
17. Right Knee Bolster Panel Assembly (Includes ELT remote switch, power point adapter, and hour meter)
18. Engine Controls – (L) Throttle; (C) Prop; (R) Mixture
19. Overhead Control Panel Dimmer Switch
    - 19.1. Left dimmer switch control reading lights
    - 19.2. Right dimmer controls instrument flood bar
20. Trim Panel – See (Figure 7 - 2).

Engine & Flight Instruments Legend

A. Left and Right Fuel Quantity
B. Manifold Pressure and Fuel flow
C. Vacuum and Ammeter
D. Tachometer
E. Oil Pressure and Temperature
F. Cylinder Head and Exhaust Gas Temperatures
G. Voltmeter and Clock/OAT- See (Figure 7 - 6)
H. A/P Annunciator for S-Tec 55
I. Optional Display (Shadin FF, Alt. Presel., etc.)
J. GPS Annunciator Control Unit – See (Figure 7 - 18)
K. Magnetic Compass

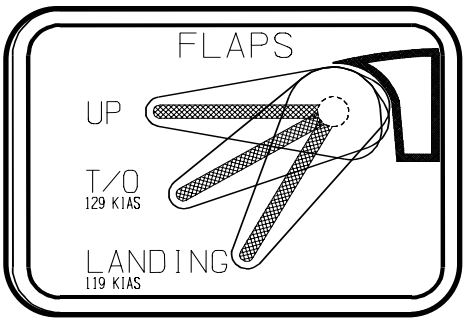
(Figure 7 - 3)

WING FLAPS

The airplane is equipped with electric Fowler-type flaps. During flap extension, the flaps move out from the trailing edge of the wing, which increases both the camber and surface area of the wing. A motor located under the front passenger's seat and protected by a 10-amp circuit breaker powers the flaps. A flap shaped switch located in the flap switch panel, which is to the right of the engine controls, operates the flaps.

The flap switch is labeled with three positions: **UP** (0°), **T/O** (12°), and **LANDING** (40°). Rotating the flap switch clockwise retracts the flaps, and moving it counter-clockwise extends the flaps. A light bar on the flap knob flashes, at approximately 2 hertz, while the flaps are in motion. When the flaps reach the selected position the flashing light stops. When landing flaps is selected, the in-transit light will not extinguish until the airspeed drops below 100 KIAS. The load caused by the higher airspeed prevents the flaps from going past approximately 37 degrees until the speed drops below 100 KIAS, and thus the load on the flaps is reduced. The illumination of the flaps does not change with adjustments to the dimmer thumb-wheel switch. Controlling light intensity and testing of the lights is discussed later in this section on page 7-45. See (Figure 7 - 3) for a drawing of the instrument panel and cockpit layout.

When the flaps are in the up position, the knob is in a position parallel to the floor and points to the UP label on the panel overlay. When flaps are in the takeoff position the knob is rotated 30° counter clockwise from UP, and pointed to the T/O label. When flaps are in the down position, the knob is rotated 30° more and points to the LANDING label. Flap extension speed placards are posted on the flap switch panel overlay. See (Figure 7 - 4) for a drawing of the flap panel.



(Figure 7 - 4)

LANDING GEAR

Main Gear – The airplane has tricycle landing gear with the two main wheels located behind the center of gravity (CG) and a nose wheel well forward of the CG point. The main gear is made from high quality rod steel that has been gun-drilled (drilled through the center like the bore of a gun barrel). The main gear is attached to a tubular steel gearbox that is bolted to the bottom of the fuselage, just aft of the wing saddle. There are 15x6.00-6 tires (tire width and rim diameter in inches) that are inflated to 55 psi and mounted to the gear with Cleveland disc brakes. Composite wheel fairings are mounted over each tire to reduce drag.

Nose Gear – The nose gear has a nitrogen and oil-filled oleo-type strut that is bolted to the engine mount and serves as a shock absorber. Forcing oil through orifices in the piston and an internal plug or barrier absorbs landing or vertical impact. A rotation key or vane working within an oil- filled pocket contains rotational movements (shimmy dampening). Both of these movements, vertical and rotational, are fully contained within the main cylinder body and under normal usage will require little maintenance. Pressurized (250 psi) nitrogen supports the aircraft weight, absorbs small shocks from taxiing, and returns the oleo to full extension.

When the airplane is on the ground, with pressure on the nose strut, the nose wheel is free castoring and has rational travel through about 120º, 60° to the left and 60° to the right. When the airplane is in flight with pressure off the nose strut, the nose wheel will self-center, which is accomplished by a key in the cylinder rod and a fixed cam. The nose tire is 5.00-5 and should be filled to 88 psi. A composite wheel fairing is mounted over the tire to reduce drag.

SEATS

Front Seats (General) – Two individual, adjustable, tubular frame seats provide the front seating for the pilot and passenger. The base of the tubular seat frame is covered with sheet aluminum, and the seat cushions are attached to the aluminum through a series of Velcro strips. The seat backs on the front seats fold forward to permit access to the aft seating area. The seat cushions and seat backs are foam filled and covered with natural leather and ultra-leather. For added protection, both the front and rear seats incorporate a special rigid, energy absorbing foam near the bottom of the cushion. The cushion is designed for the loads applied by a seated passenger, and it is possible to damage the seat if concentrated loads are applied. Care must be taken to avoid stepping on the seats with high-heeled shoes or placing heavy objects on the seat that have small footprints.

Front Seat Adjustment – The front seats are adjustable fore and aft through a range of approximately seven inches. The adjustment control for the seats is located below the seat cushion on the left side. To adjust the position of either seat, move the control lever towards the middle until the seat unlocks from the seat track and adjust the seat to the desired position. Release the adjustment control when the seat is in the desired position, and test for positive seat locking by applying a slight fore and aft movement to the seat cushion. The tilt of front seat backs is adjustable on the ground by loosening the jam nut on the coarse-threaded bolts on each side of the seatback and then raising or lowering the bolts that control the tilt of the seat. See Chapter 25 in the maintenance manual for specific limitations.

Rear Seats – The rear seats are a split bench-type design and are nonadjustable. The bench seat frame is composite construction and bolted to the interior of the fuselage. The foam filled seat and seat back cushions are covered with natural leather and ultra-leather and attached to the seat bench with Velcro fasteners. The seatbacks are attached to a metal crossbar and secured with quick release pins; however, removal of the rear seat back is not permitted for normal operations.

SEAT BELTS AND SHOULDER HARNESSES

The seat belts and shoulder harnesses are an integrated three-point restraint type of design. With this type of restraint, the lap belt and diagonal harness are incorporated using one continuous piece of belt webbing. The webbing is anchored on each side of the seat for the lap belt restraint and then in the overhead for the harness restraint.

Use of the three-point restraint system is accomplished by grasping the male end of the buckle, drawing the lap webbing and diagonal harness across the lower and upper torso, and inserting it into the female end of the buckle. There is a distinctive snap when the two parts are properly connected. Adjusting two devices in the lap-webbing loop varies the length of the lap belt. One end of the adjustment loop contains a dowel, and the other has a small strap. Draw the dowel and strap together to enlarge the lap belt size, and draw them apart to tighten the lap belt. To release the belt, press the red button on the female portion of the buckle. The torso part of the webbing is on inertial reels that permit the freedom of movement required for piloting operations and passenger comfort. In case of rapid deceleration, the inertial reel will engage a locking mechanism and provide positive restraint.

DOORS

WARNING

Do not open any of the airplane doors in flight. The doors are not designed to be opened in flight; subsequent airloads on an opened door will forcefully pull it completely open and detach it from the airplane.

Gull Wing or Cabin Doors – The airplane has entrance doors on each side, which permits easy access to front and rear seat positions. The doors are hinged at the top and open to an almost vertical position above the fuselage. The doors are part of the fuselage contour and when both are fully opened, have a gull wing type of appearance. In the full up or full open position, each door is supported and kept open by a gas strut. The strut will only hold the door open when the door is in the vertical or near vertical position.

The hinges, in conjunction with the dual slide bolts of the door latching mechanism, which extend through the fore and aft door jam, keep the door secure with four points of contact. A distinction is made here between the latching mechanism and the security door locks. The latching mechanism ensures that the doors will remain secured during flight. The door locks are primarily antitheft devices and restrict use of the latching mechanism.

The aircraft should never be taxied while the doors are in the full up position. The doors may be opened 6 to 8 inches during taxi, which can be controlled by grasping the arm rest.

Latching Mechanism – From the exterior, the latching mechanism on each cabin door is operated through movement of the exterior door handle. The handle is mounted on the side of the door in the bottom-aft position and has two ranges of movement. The handle is recessed into the door with adequate room for a handhold. A safety release on the handle must be disengaged before the door will open. Pulling the handle away from the door activates the release. Moving the forward end of the handle from its normal middle position to the six o'clock position disengages the latching mechanism. To secure the door, return the handle to the middle position.

From the interior, both latching mechanisms are engaged and disengaged through use of a handle near the bottom-aft position of the interior door. Again, pulling the handle away from the door disengages the safety release. To activate the latching mechanism, move the door handle down from its near horizontal position until the slide bolts are fully engaged and the curved end of the handle is resting in the safety detent. There are placards on the interior doors labeled "Open" and "Closed" with direction arrows. When both doors are properly closed with the latching mechanism and the baggage door is secured and locked, the "Door Open" annunciator in the upper left position of the annunciator panel will not be lit, and the aural warning will silence.

WARNING

If the red "Door Open" annunciator light is on or the aural warning is playing, then one or more doors are not properly secured and the airplane is unsafe to fly.

Door Locks – There are door locks for each door that restrict use of the latching mechanism and are intended as antitheft devices. The door lock on the pilot's side is a tube-type lock and is operated with a key. On the passenger's side, there is an interior latch control for locking the door. The keyed lock and the latch are moved counterclockwise to lock the door.

To lock the airplane, first engage the door latching mechanism on the passenger side, and then activate the door lock by moving the interior latch. Next, close and latch the pilot's door, and use the key to activate the door lock. Ensure that the baggage door is locked. The passenger's door must not be locked during flight operations. Locking the door would inhibit rescue operations in case of an emergency.

Door Seal System – The airplane is equipped with a pneumatic door seal system that limits air leakage and improves soundproofing. An inflatable gasket around each main door expands when the door seal system is turned on. An electrical motor near the pilot's rudder pedals operates the system, which maintains a differential pressure of 12 to 15 psi. The system is activated by a switch in the rocker switch panel labeled "Door Seal" and is protected by a five-amp circuit breaker. The cabin and baggage doors must be closed for the door seal system to operate. The latching mechanism of each door moves a micro switch, which turns off the Door Open annunciator. The Door Open annunciator must be extinguished for the door seal system to operate.

The cabin door latching mechanism also controls the dump door seal valve. When either cabin door latching mechanism is moved more than a half inch towards the open position, the dump valve is engaged and the pressure in the seals is dumped. This prevents inadvertent operation of the doors when they are sealed; however, setting the door seal switch to the off position after landing is recommended.

Normally, the door seal switch remains in the On position for the entire flight. If the system pressure drops below 12 psi, the air pump will cycle on until pressure is restored. If the pump runs continuously, it is an indication that a seal is damaged and incapable of holding pressure. In this situation, the door seal system should not be operated until repairs are made.

Baggage Door – The baggage access door is located on the left side of the airplane, approximately two and one half feet from the left cabin entrance door. The door has Ace type locks on each side of the door, and both locks are used to secure and unsecure the door. There is a piano hinge at the top and the door is held open by a gas strut during loading and unloading operations.

To open the baggage door, insert the key into each lock and rotate 90º clockwise. The key cannot be removed from the forward baggage door lock; hence, when opening it, the aft lock is released first. Once the aft lock is unlatched, remove the key and open the forward lock. This design reduces the possibility of taking off with the baggage door open, provided the ignition and baggage door keys are on the same key ring. When the second lock is unlatched, the gas strut will raise the door. The baggage door is part of the door annunciator system. If the baggage door is not properly closed and the forward latch secured, the red "Door Open" light in the annunciator panel will illuminate and the aural warning will sound.

Step (Installed) – On each side of the airplane there is an entrance step mounted to the fuselage and located aft of the flaps. The entrance step is used for access to the airplane; however, the flaps cannot be stepped on during ingress and egress operations. Placing weight on the top of the flaps imposes unnatural loads on the control's surface and hardware and may cause damage. Both flaps are placarded with the words "No Step."

Step (Not Installed) – Some owners prefer to not have the step installed since it lowers cruise speed by about two knots. Some of these owners may prefer to carry a small step ladder/stool to assist passengers in entering and exiting the airplane. The pilot must, in this instance, enter and

exit the airplane without the use of a portable device. If a portable step is not used, it is recommended that entering and exiting the airplane be made from the front of the wing. The easiest method of ingress or egress is to sit on the wing facing forward and then stand up.

Handles – Optional fuselage handles are available with certain aircraft to assist entering the aircraft. The handles are located behind the passenger windows. Do not hang or otherwise put your full weight on the handles.

BRAKE SYSTEM

The airplane braking system is hydraulically operated by a dedicated braking system. Each rudder pedal has a brake master cylinder built into it. Depressing the top portion of the rudder pedals translates this pressure into hydraulic pressure. This pressure is transmitted through a series of hard aluminum and steel grade Teflon lines to pistons in the brake housing of each brake. The piston activates the brake calipers that apply friction to the chrome steel discs. Each disc is connected to a wheel on the main landing gear and when the caliper clamps onto the disc, it creates friction, which impedes its rotation. Since the disc is part of the wheel, the friction on the disc slows or stops the forward momentum of the airplane.

Parking Brake – The parking brake is near the floor, forward of the circuit breaker panel on the pilot's side of the airplane. When disengaged, the handle is flush with the side panel. The black handle is placarded with the red lettered statement, "Brake Engaged," which is only visible when the brake is engaged. To operate, apply and maintain brake pressure to both brakes, and move the parking brake control 90° clockwise by grasping the forward portion of the handle. Once the parking brake handle is set, release pressure on the brake pedals.

Moving the parking brake control to the "On" position causes a valve to close the line between the master cylinders and the parking brake. The pressure introduced by the foot pedals before the brake was set is maintained in the system between the parking brake handle and the brake housing. To release the parking brake, apply pressure to the brake pedals, and move the parking brake selector 90° counterclockwise or back to the flush position. When the parking brake is on, the position of the handle restricts access to the left rudder pedal and limits inadvertent operation with the parking brake system engaged.

Steering – Directional control of the airplane is maintained through differential braking. Applying pressure to a single brake introduces a yawing moment and causes the free castoring nose wheel to turn in the same direction. As is the case with most light aircraft, turning requires a certain amount of forward momentum. Once the airplane is moving forward, applying right or left brake will cause the airplane to steer in the same direction. There are two important considerations. First, use enough power so that forward momentum is maintained, otherwise the differential braking will stop the airplane. Second, avoid the tendency to ride the brakes since this will increase wear. Some momentary differential braking may be required for takeoff until the control surfaces become effective.

ENGINE

ENGINE SPECIFICATIONS

The airplane engine is a Teledyne Continental Motors Aircraft Engine Model IO-550-N. It is a horizontally opposed, six-cylinder, fuel injected, air-cooled engine that uses a high-pressure wet-sump type of oil system for lubrication. There is a full flow, spin-on, disposable oil filter. The engine has top air induction, an engine mounted throttle body, and a bottom exhaust system. On the front of the engine, accessories include a hydraulically operated propeller governor and a gear driven alternator. Rear engine accessories include a starter, gear-driven oil pump, gear-driven fuel pump, and dual gear-driven magnetos and vacuum pumps.

ENGINE CONTROLS

Throttle – The throttle controls the volume of air that enters the cylinders. The control has a black circular knob and is located to the right of the rocker switch panel and above the radios. The throttle has a friction control collar that increases or decreases the pressure required to advance or retard the control. It is used to lock the throttle at a particular manifold pressure setting. When it is turned clockwise, the friction is increased; turning counterclockwise decreases the friction. Changes in throttle settings are displayed on the manifold gauge. Moving the throttle forward increases engine power and manifold pressure, while moving it back will reduce power and manifold pressure.

Propeller – The propeller control allows the pilot to vary the speed or RPM of the propeller. The control has a blue knob with large raised ridges around the circumference and is located between the throttle and the mixture controls. The control has a vernier feature, which permits small adjustments by rotating the knob either clockwise (increase) or counterclockwise (decrease). Large adjustments, such as "exercising the prop" (moving the control to the full aft position), can be made by pressing in the locking button in the center of the knob and moving the control as desired. The high-speed position is with the control full forward.

Mixture – The mixture control allows the pilot to vary the ratio of the fuel-air mixture. The control has a red knob with small raised ridges around the circumference and is located to the left of the flap switch, above the radios. The control has a vernier feature, which permits small adjustments by rotating the knob either clockwise (increase) or counterclockwise (decrease). Large adjustments, such as when the control is set to idle cut-off (moving the control to the full aft position), can be made by pressing in the locking button in the center of the knob and moving the control as desired. The richest position is with the control full forward.

ENGINE SUB-SYSTEMS

Starter and Ignition – Turning the keyed ignition switch, which is located on the master switch panel, activates the starter. This panel is on the extreme left side of the cockpit just to the left of the rocker switch panel. The key rotates in a clockwise direction and is labeled: "Off" – "R" – "L" – "Both" – "Start." The "R" and "L" items of this label relate to which magneto (left or right) is turned on or not grounded. Turning the key to "Both" (approximately straight-up) will cause both magnetos to be ungrounded or "Hot."

The airplane engine is equipped with TCM-Bendix S6RN-25 series, high-tension magnetos with impulse couplings on each magneto. The left magneto fires the three upper left and lower right set of spark plugs, and the right magneto fires the three upper right and lower left set of spark plugs. Turning the switch to the "L" or left magneto grounds the right magneto and makes it non-functioning. Conversely, turning the switch to the "R" or right magneto position grounds the left magneto and makes it non-functioning.

The key will turn with minimum resistance to the "Both" position and is spring-loaded (provides greater resistance) from the "Both" to the "Start" position. Starting is initiated from the "Both" position with the master switch on. Rotating the key to the start position will engage the starter. Once the engine starts, release the key, and the spring loading mechanism will return it to the "Both" position. A geared right-angle drive starter adapter and a direct current starter motor accomplish engine cranking.

Propeller and Governor – The airplane is equipped with a Hartzell three-bladed constant speed propeller with a McCauley governor. In a constant speed propeller system, the angle of the propeller blade changes automatically to maintain the selected RPM. For this to happen the angle of the propeller blade must change as power, air density, or airspeed changes. A decrease in blade angle decreases the air loads on the propeller, while an increase in blade angle increases air loads. If, for example, the manifold pressure is reduced, the angle of the blade will decrease (decreased air loads) to maintain a constant RPM. When operating at high altitudes with reduced air resistance, the blade angle will increase (increased air loads) to maintain a constant RPM.

An oil-driven piston in the propeller hub uses oil from the engine oil system to operate the propeller governor. If a greater blade angle is needed to maintain a constant RPM, the valve in the governor pumps oil into the propeller hub to increase the propeller blades' angle of attack. If a smaller blade angle is needed to maintain a constant RPM, the governor diverts oil away from the piston. With oil pressure removed, spring pressure and a centrifugal blade twisting moment cause the propeller blades' angle of attack to decrease. The propeller is connected directly to the drive shaft of the engine; hence, propeller and engine RPM indications are the same.

There are limits at which the propeller can no longer maintain a constant RPM. As power is reduced, the blade angle decreases to maintain a constant RPM. When the propeller reaches its lowest angle of attack position, approximately 14°, further reductions in power will result in decreased RPM. The highest propeller blade pitch angle is about 35º; which was selected to be high enough to keep the engine from overspeeding in a Vne dive. The high pitch stop will never be reached in flight under normal conditions.

The sequence in which power changes are made is important. The objective is to not have a high manifold pressure setting in conjunction with a low RPM setting. When increasing power settings, increase RPM first with the propeller control, and then increase manifold pressure with the throttle. When decreasing power settings, decrease the manifold pressure first and then decrease the RPM setting. **Do not exceed 20 inches of Hg of manifold pressure below 2200 RPM. This requirement is not an engine limitation, but rather a harmonic condition inherent in the Columbia 300 (LC40-550FG).**

Induction – The induction system routes outside air through an air filter to the throttle valve and then to each individual cylinder where fuel from the injector nozzle of the cylinder is mixed with the induction air. The components of the induction system include air filter and a heated induction air door. Normally, ram air enters through the left intake hole in the front of the cowling and passes through the air filter where it is sent on to the fuel manifold.

In the event the normal induction system is obstructed by ice, there is a control, which permits introduction of heated air into the induction system. This control is below the rocker switch panel near the pilot's left knee and labeled "Induction Heat." Heated induction air is routed through the induction system when the knob is pulled out. The ram air intake is located by the right intake hole in the front of the cowling. When the induction heat control is pulled out, it moves a

butterfly valve that shuts off the airflow of outside induction air and opens the airflow for heated air from the engine. There is no need for an air-to-air heat exchanger manifold. The ambient air that circulates around the engine provides a sufficient temperature rise for the heated induction air.

Cooling – The airplane has a pressure cooling system. The basic principle of this design is to have high pressure at the intake point and lower pressure at the exit point. This type of arrangement promotes a positive airflow since higher-pressure air moves towards the area of low pressure. The high-pressure source is provided by ram air that enters the left and right intake openings in the front of the cowling. The low pressure point is created at the bottom of the cowling near the engine exhaust stacks. The flared cowl bottom causes increased airflow, which lowers pressure.

Within the cowling, the high-pressure intake air is routed around and over the cylinders through an arrangement of strategically placed baffles as it moves towards the lower pressure exit point. In addition, fins on the cylinders and cylinder heads, which increase the surface area and allow greater heat radiation, promote increased cooling. The system is least efficient during ground operations since the only source of ram air is from the propeller or possibly a headwind.

Engine Oil – The IO-550-N has a wet sump, high pressure oil system. The system provides lubrication for the moving parts within the engine and is the oil source for operation of the propeller governor. In addition, a squirt nozzle that directs a stream of oil on the inner dome of each piston cools each piston. The engine has an oil cooler with a pressure-temperature bypass. The oil bypasses the oil cooler if the oil temperature is below 170°F (77°C) or a pressure differential greater than 18 psi is detected. If the oil temperature is above 170°F (77°C), oil is sent through the oil cooler before entering the engine. This type of arrangement keeps the oil at constant temperature of about 180°F (82°C). Ram air for the oil cooler is provided by the engine's pressure cooling system.

The term "wet sump" means the oil is stored within the engine sump as opposed to a separate oil tank. The oil is drawn out of the sump by the engine-driven oil pump where it is sent to a full flow oil filter, i.e., a filter that forces all the oil to pass through the filter each time it circulates. The system pressure is kept constant by a spring-loaded pressure relief valve that is between the pump and the filter. From the oil filter, the oil flows into the oil cooler if the temperature is high enough and then is routed to the left oil gallery (an oil dispersal channel or passage). The oil in the left gallery flows forward to the front of the engine and a portion of the flow is sent to the propeller governor. The oil flow is then directed to the right engine gallery and flows towards the rear of the engine and back to the oil sump.

Oil within the left and right galleries is injected onto the crankshaft, camshaft, propshaft bearing, accessory drive bearings, cylinder walls, and other various parts within the engine. After lubricating the engine, gravity causes the oil to flow downward through transfer tubes and drain holes where it is returned to the oil sump.

If the filter becomes clogged and prevents oil from moving through the system, a bypass valve reroutes the oil around the filter. In this event, the lubricating oil is, of course, unfiltered. However, rerouting the oil will prevent engine failure. It is important to note that the pilot will have no indication that the oil filter has clogged, and this situation compounds the problem. Since the filter failure was most likely caused by contaminated oil, the oil system will be lubricated with contaminated oil. The best solution is timely and frequent oil changes.

The dipstick and oil filler cap access door are located on the top left engine cowl about two feet from the propeller hub. The engine must not be operated with less than six quarts of oil and must not be filled above eight quarts. For extended flights, the oil should be brought up to full capacity. Information about oil grades, specifications, and related issues are covered in Section 8 of this handbook.

Exhaust – Gases that remain after combustion flow from the cylinders through the exhaust valves and into the exhaust manifold (a series of connected pipes) and are expelled into the outside atmosphere. There is an exhaust manifold on each side of the engine, and each of these manifolds is connected to three cylinders. The manifolds are connected to a muffler and tail pipe that extend out the bottom of the engine cowling. A heat shroud is attached to the exhaust pipe on the left side and serves as a heat exchanger. The air-to-air heat exchanger is used for cabin heat.

INSTRUMENTS

ENGINE INSTRUMENT PANEL

The operation and use of engine instruments and the instruments for accessory items connected to the engine, such as the vacuum pump and alternator, are discussed below. While some of these instruments display information about systems that are not directly related to the operation of the engine, they are included here for convenience to permit discussion and referencing under one heading. In addition, reference is made to the annunciator panel since many of its indications are associated with the engine and engine related instruments. The annunciator panel is described in more detail on page 7-24 of this section. The instruments discussed below are in the engine instrument panel, which is on the left side of the airplane to the left of the flight instrument panel. The panel is canted about 30° in relation to the flight instrument panel. See (Figure 7 - 3) for a drawing of the instrument panel.

Fuel Quantity – The fuel quantity gauges are in the engine instrument panel in the top-left position. The instrument is a dual presentation gauge with the left tank fuel quantity on the left side and the right tank fuel quantity on the right side. The gauge displays the amount of available usable fuel, in U.S. gallons, in each tank. The dials for each gauge range from 0 gallons (red placard) to 49 gallons with major increments of 10 gallons and minor increment of 5 gallons. There are two green lights on the left and right side of the gauge that illuminate to indicate which tank is selected. The lights will only work when the fuel selector is properly seated in the left or right position. Controlling light intensity and testing these lights is discussed later in this section on page 7-45. The pilot is reminded that the fuel gauges are approximate indications and are never substitutes for proper planning and pilot technique.

Manifold Pressure – The manifold pressure gauge is in the engine instrument panel in the top-right position. The instrument is a dual presentation gauge with manifold pressure indications on the left and fuel flow readings on the right. Changes in throttle settings are displayed on the manifold pressure gauge in inches of mercury (inches of Hg.) as it measures the absolute pressure in the engine intake manifold, behind the throttle valve. The manifold pressure gauge has increments that range from 0 to 30 inches of Hg. but does not have colored arcs or limitations displayed on the instrument. The electronically powered gauge will not operate with the master switch off.

Fuel Flow/Fuel Pressure – The fuel flow/fuel pressure gauge is in the engine instrument panel in the top-right position. The instrument is a dual presentation gauge with manifold pressure indications on the left and fuel flow/pressure readings on the right. Changes in throttle or mixture settings will produce changes in the fuel flow/pressure readings. Readings for this gauge are obtained by measuring the fuel pressure on the metered side of the fuel system and converting it into a related fuel flow reading. The instrument displays gallons per hour (GPH) and ranges from 0 GPH to 25 GPH. The top and bottom of the gauge have fuel pressure markings that range between 4 and 18 psi. The gauge is electronically operated and will not display a reading with the master switch turned off.

Vacuum – The vacuum gauge is in the engine instrument panel in the center-left position. The instrument is a dual presentation gauge with the vacuum gauge on the left and ammeter indications on the right. The gauge measures vacuum or suction in inches of mercury (inches of Hg. below ambient pressure) in major increments of one inch Hg. The normal operating limits (Green Arc) displayed on the gauge range from 4.5 inches of Hg. to 5.2 inches of Hg. The vacuum gauge measures the absences of pressure directly from the vacuum system and operates independently from the electrical system of the airplane.

Ammeter – The ammeter is in the engine instrument panel in the center-left position. The instrument is a dual presentation gauge with the vacuum gauge on the left and the ammeter on the right. The ammeter measures the condition of the battery in terms of charging or discharging. The range of the indications run from a + 60 amps to – 60 amps in 30 amp increments. While there is no placarded operating range, under most conditions the instrument should indicate a positive charging state. The master switch must be on for the ammeter to operate.

Tachometer – The tachometer is in the engine instrument panel in the center -right position. Changes in RPM settings are displayed on the tachometer in increments of 100 RPM with the red line at 2725 RPM. A green arc indicates the range for normal operations, 2000 to 2700 RPM. The gauge is electronically operated and translates the rotor speed of the right magneto into an equivalent engine RPM reading. Since the tachometer is electrically powered, it will not display a reading with the master switch turned off.

Oil Temperature – The oil temperature gauge is in the engine instrument panel in the bottom-left position. The instrument is a dual presentation gauge with the oil temperature gauge on the left and oil pressure gauge on the right. The gauge measures oil temperature in degrees Fahrenheit (°F) in 20 °F increments. The normal operating limits (Green Arc) displayed on the gauge range from 170°F to 200°F with a red line upper limit of 240°F. The thermal bulb, which is the source point for measurement of oil temperature, is located near the oil cooler. Power for the temperature gauge is supplied by the airplane's electrical system, and the oil temperature gauge will not operate with the master switch turned off.

Oil Pressure – The oil pressure gauge is in the engine instrument panel in the bottom-left position. The instrument is a dual presentation gauge with the oil temperature gauge on the left and oil pressure gauge on the right. The gauge measures oil pressure in pounds per square inch (psi) in increments of 10 psi. The normal operating limits (Green Arc) displayed on the gauge range from 30 psi to 60 psi. The lower limit of 10 psi is not placarded. An electrical transducer mounted to the oil cooler converts pressure changes into electrical voltages. Power for the transducer is supplied by the airplane's electrical system, and the oil pressure gauge will not operate with the master switch turned off.

Cylinder Head Temperature (CHT) – The CHT gauge is in the engine instrument panel in the bottom-right position. The instrument is a dual presentation gauge with the exhaust gas temperature (EGT) gauge on the left and CHT readings on the right. The CHT gauge displays cylinder head temperature in degrees Fahrenheit (°F). The green arc or normal operating limits, range from 240°F to 460°F with a red line above 460°F. The source of the temperature reading is a direct measurement from a bayonet probe in the No. 2 cylinder, which is normally the hottest cylinder. While the CHT is a voltage-generating temperature indicator, commonly referred to as a thermocouple, the transmitting unit uses the electrical system of the airplane, and the gauge will not operate if electrical power is lost or the master switch is turned off.

Exhaust Gas Temperature (EGT) – The EGT gauge is in the engine instrument panel in the bottom-right position. The instrument is a dual presentation gauge with the exhaust gas temperature (EGT) gauge on the left and CHT readings on the right. The EGT gauge does not quantify exhaust gas temperatures in terms of a numerical reading. Rather, the instrument serves as an efficiency reference since it measures relative temperature, not actual. The graduations are unlabeled and in increments of 25°F. There is a manually set reference pointer that is controlled by a knob in the left-center of the dial. The EGT is calibrated to a base indication of 1250ºF to

1275ºF. Therefore, when the EGT needle is four increments from the bottom, the actual temperature is 1350ºF to 1375ºF.

The primary use of the EGT is for proper mixture control since the indications reflect combustion efficiency. Compared to CHT, the measurement is more direct and mixture adjustments are reflected almost immediately. (Please see the discussion on page 4-21 for proper mixture leaning techniques.) The EGT measurement location is at the exhaust manifold of cylinder No. 2. The EGT is a voltage-generating temperature indicator, commonly referred to as a thermocouple, and operates independently from the electrical system of the airplane.

FLIGHT INSTRUMENT PANEL

All flight and navigational instruments are installed in this particular area. In addition, there is an annunciator array located in the upper right portion of the flight instrument panel. The panel is directly in front of the pilot, and the instrument presentation is contained in three rows. Directly above the annunciator panel is an acknowledge button for the aural warning system. The discussion that follows will identify each instrument, moving from left to right and down the rows. A drawing of the airplane cockpit is shown on page 7-12.

Annunciator Panel – The presentation of the annunciator panel is shown in (Figure 7 - 5). The number below each label identifies the page number that contains the relative discussion. Controlling light intensity and testing these lights is discussed in this section on page 7-45.

FUEL VALVE 7-37	FUEL PUMP 3-15 & 7-39		L LOW FUEL 7-38	R LOW FUEL 7-38		RESERVED
DOOR OPEN 7-15	ALT 3-22/7-42	OIL 3-21	RUDR LMTR 7-47	LVAC 7-34	RVAC 7-34	SPDBRK (Optional) Supplement No. 3
Above Messages Indicated with Red Lights			Above Messages Indicated with Amber Lights			

(Figure 7 - 5)

1. If the **DOOR OPEN** light is on, one or more of the airplane's doors is not properly secured.
2. If the **FUEL VALVE** light is on, the fuel selector is not set to either the left or right tank, or is not properly seated in the detent of the selected tank.
3. If the **ALT** light is on, the alternator has failed or was tripped off-line by an over voltage condition. In either case, the battery is in a state of discharge.
4. If the **OIL** light is on, the engine oil pressure is less than 5 psi.
5. If the **FUEL PUMP** light is on, the engine driven pump has failed, and the backup boost pump must be armed.
6. If the **RUDR LMTR** light is on, left rudder travel is limited to 12º.
7. If either the **LVAC** or **RVAC** light is on, the indicated vacuum pump is inoperative.
8. If either the **L LOW FUEL** or **R LOW FUEL** light is on, the indicated tank has less than eight gallons of usable fuel remaining in that tank.
9. If the SPDBRK light is on, the speed brakes are deployed.

Aural Warning – The aural voice warning system is installed in addition to most of the red annunciators. Any warning that causes a red annunciator to illuminate (except for oil pressure)

will also cause the aural warning to activate. In addition, the aural system is integrated with the Davtron clock, and will provide a reminder when the countdown timer reaches zero.

The aural warning system operates when the avionics master is on and there is engine oil pressure. This feature prevents the warning system from going through all the commands when power is first applied. There is also a two second delay to allow fuel tank selection without a nuisance warning.

An acknowledge button is located below the annunciator panel's red lights and is accessible to both the pilot and copilot. Pressing the acknowledge button stops the played annunciation until the next annunciation is triggered. The aural warning will play when it receives an input from the annunciator panel to the appropriate pin of the warning device. This causes the message to be played, repeating every two seconds until the acknowledge button is pushed. If more than one warning is detected, each affected alert will be played at least once regardless of when the acknowledge button is pressed.

The aural warning will be played over the cabin speaker and the headsets regardless of the audio panel switch positions. The aural warnings consist of a female voice speaking in English. The aural warnings that play are:

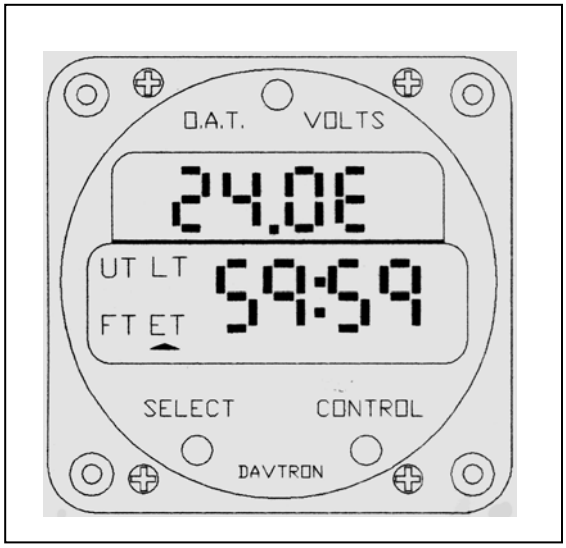
1. Door Is Open – this warning is activated when any of the doors are unlatched and the engine RPM is over 1800 RPM
2. Alternator Off – this warning is activated when any of the following occur.
    a. The alternator is switched off.
    b. The overvoltage relay has been activated.
    c. The bus voltage is below 12.0 volts DC.
    d. The alternator has failed.
3. Fuel Valve – this warning is activated when the fuel valve is not in the left or right tank detents.
4. Fuel Pump On – this warning is activated when the fuel pressure is less than 5 psi.
5. Timer at Zero – this annunciation is activated by the Davtron clock and is programmed by the pilot.

Magnetic Compass – The airplane has a conventional aircraft, liquid filled, magnetic compass with a lubber line on the face of the window, which indicates the airplane's heading in relation to magnetic north. The instrument is located on top of the glare shield and is labeled at the 30° points on the compass rose with major increments at 10° and minor increments at 5°. A compass correction card is on the compass and displays compass error at 30° intervals with the radios on.

Voltmeter/OAT/Clock – This instrument contains three separate indications. The upper window is dedicated to voltmeter and outside air temperature readings, and the lower window is a multi-function timepiece. See (Figure 7 - 6) for a drawing of the instrument. There are three control buttons on the face of the indicator. Pressing the top button, labeled O.A.T. and VOLTS, will cycle the reading in the upper Liquid Crystal Display (LCD) from a voltage reading, to an outside air temperature in °F, to an outside air temperature reading in °C. The lower two buttons, labeled SELECT and CONTROL, are for the multi-function clock and are discussed under clock features in paragraph 3 below.

1. **The voltmeter** displays the system's bus voltage and under normal conditions should indicate about 14.2 volts. At 16 volts, the voltage regulator will take the alternator off-line, and at approximately 8 volts, electrical equipment will cease to operate or will operate erratically. The voltmeter is electrically powered and will not operate if the master switch is turned off.

2. **The outside air temperature (OAT) gauge** measures the ambient air temperature from a probe located on the forward access panel, under the right wing, just forward of the fuel vent. The temperature is digitally displayed in either °F or °C depending on which mode is selected. The OAT is electrically powered and will not operate if the master switch is turned off.
3. **The digital clock** displays four time modes: universal time (UT), sometimes referred to as Greenwich Mean Time (GMT), local time (LT), flight time (FT), and elapsed time (ET). The time mode selected is indicated in the lower digital display window on the left side with a flashing underscore below the selected time mode. In (Figure 7 - 6) the ET time mode is selected. Pressing the Select button several times cycles the display through the four time modes in the order they are listed.
   a. **The Universal Time (UT)** display is in hours and minutes and based on the 24-hour clock. To reset the UT clock, ensure that the display is in the UT mode, which is indicated by the flashing underscore below the UT in the display window. Next, press the Select and Control buttons at the same time to enter the time reset mode. This will cause the first digit in the LED to flash, which indicates that this is the number that can be controlled or changed. Next, press the Control button, and the flashing number will increase. When the desired number is set in, press the Select button, and the next digit will flash. Again, adjust this number with the Control button until the desired number is set. The last two digits, the minutes, are set in the same manner, and one final push on the Select button exits the UT time reset mode. It is important that the reset procedure for the UT mode is clearly understood as it will be referenced several times in the following discussion.
   b. **The Local Time (LT)** display is in hours and minutes and based on the 12-hour clock. In the LT mode, the time is normally set to the local time zone in which the airplane is operated, i.e., PST, EDT, etc. The clock is reset in the same manner as described in the previous paragraph for the UT mode, except the Select button is used to underscore the LT prior to entering the time reset mode. It is neither necessary nor possible to reset the minute's display since they are synchronized with the UT clock.
   c. **The Flight Time (FT)** mode is useful for keeping track of the approximate flight hours for a particular trip or series of trips. The recorder indicates time in hours and minutes up to 99 hours and 59 minutes. The recorder is not an actual measurement of flight time since it operates or counts up whenever the master switch is on and the system has oil pressure. Pressing the Select button until the FT is underscored in the display window accesses the FT mode. The flight time can be reset to 00:00 from FT mode by pushing the Control button for approximately three seconds. On airplane serial numbers 40004 to 40015, the flight timer will not function unless Service Letter 01-011 is incorporated.



(Figure 7 - 6)

1. **The Flight Time Alarm** – This feature is helpful for reminding the pilot to perform some action in the future. Suppose that fuel tanks are to be switched in one hour and the current flight time indication is 02:30 hours. From the FT mode (FT underscored), press both the Select and Control buttons at the same time for one second to enter the flight alarm set mode. Set in the desired future flight time indication in hours and minutes, in this case 03:30, for alarm activation. The number is input in the same manner described for the UT reset. When the flight time reaches 03:30, the LED indication will flash. If the FT mode is not displayed at the time the alarm becomes active, and the clock automatically selects the FT mode for display. Pressing either the Select or Control buttons turns off the alarm. The flight time is unchanged and will continue counting.
2. **The Elapsed Time (ET) count up timer** is extremely useful for a number of flight operations, and its use is simple and straightforward. Using the Select button, move the underscore until the clock is in the ET mode. Press the Control button, and the timer will start counting. Elapsed time counts up to 59 minutes and 59 seconds and then switches to hours and minutes. It continues counting up to 99 hours and 59 minutes. Pressing the control button again resets the ET to zero.
3. **The Elapsed Time (ET) countdown timer** has a number of applications; however, it requires a few more setup steps. Suppose a pilot is on an instrument approach, and from the VOR it is calculated that at two minutes and thirty seconds the airplane will be at the missed approach point. In this instance, to time the approach, the clock is preset to a 02:30 standby state and then is activated when crossing the VOR.

   The time is entered the same as described for the UT mode; however, the final input to the Select button to exit the reset mode will not start the countdown timer. Rather, the timer will display the preset 02:30 setting and start the countdown when the Control button is pressed. When the ET countdown timer reaches zero, the display will flash, and the timer will start counting up. Pressing the Control button once will stop the display from flashing, and a second push on the Control button will reset the ET timer to zero. The ET countdown time can be set for times up to 59 minutes and 59 seconds.
4. **To test the clock**, hold the Select button in for three seconds. This will cause the display to read 88:88 with all four modes underscored. When electrical power is first turned on, the top display will indicate the system's voltage, and the clock will display the mode it was in when the electrical power was turned off. When the electrical system of the airplane is not on, a

backup AA battery holds the time and other settings such as flight time in the memory of the clock. The battery has a three-year life, but it is recommended that it be replaced every two years. Incorrect time and mode readings during power up are indications of an expended or defective backup battery.

Remote Marker Beacon Repeater Indicator – A remote marker beacon (MB) repeater indicator (Outer, Middle, and Inner Markers) is located above the artificial horizon. The three remote lights are connected to the SL10 audio panel, which contains the receiver and controls for the remote marker beacons. MB annunciations are also displayed on the SL10 audio panel and provide a backup source for station passage. The operation of the marker beacon receiver is covered on page 7-49 as part of SL15 audio panel discussion. The remote marker beacon repeater indicator must be functional for IFR operations.

14H Annunciator Control Unit (ACU) – This area on the panel contains indications and function switches for the Global Positioning System (GPS) and selection of which navigational source (GPS or VOR) is displayed on the navigation indicator. A discussion of these switches begins on page 7-49.

Airspeed Indicator – The airspeed indicator is part of the pitot-static system, which is discussed on page 7-33. The instrument measures the difference between ram pressure and static pressure and, through a series of mechanical linkages, displays an airspeed indication. The source of the ram pressure is from the pitot tube and the source of the static pressure is from the static air vent. The instrument shows airspeed in knots on the outer circumference of the instrument, which ranges from 0 to 260 knots with 10-knot increments. Airspeed limitations in KIAS are shown on colored arcs as follows: white arc – 57 to 119 knots; green arc – 71 to 179 knots; yellow arc – 179 to 235 knots; and red line – 235 knots.

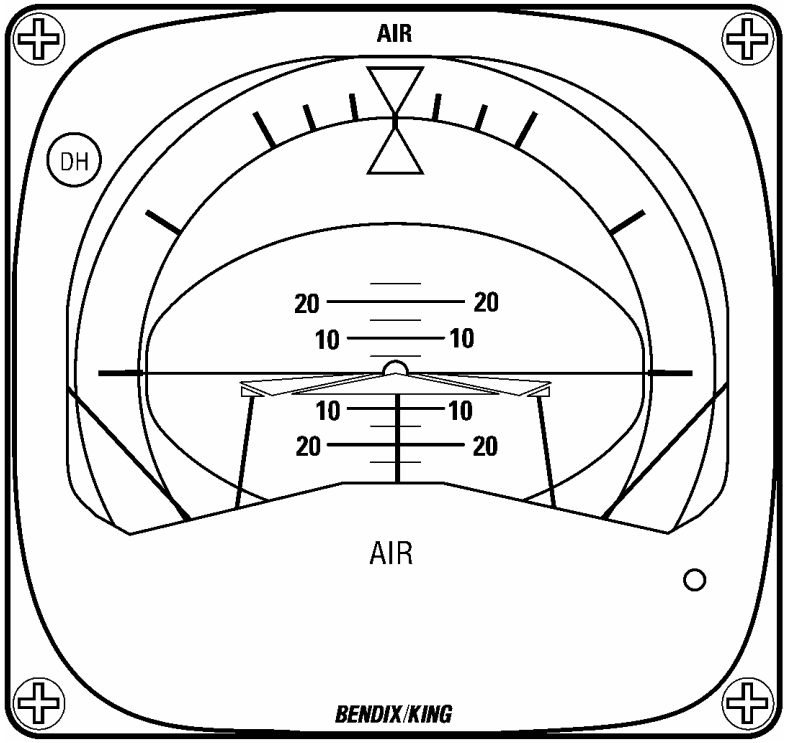
True airspeed (TAS) is obtainable for indicated airspeeds between 135 and 215 knots by reference to the true airspeed ring on the outer portion of the dial, approximately between the five thirty and ten o'clock positions. The adjustment knob for this function is near the five o'clock position on the airspeed indicator. Moving the knob causes the pressure altitude scale in a window at the top of the instrument to move under a stationary temperature scale. Rotate the knob until the pressure altitude (in increments of 1000 feet) is opposite the temperature (°C in increments of 10°), and read the TAS on the true airspeed ring. Greater accuracy is produced if calibrated airspeed is used rather than indicated airspeed.

Integrated Flight System (IFS) – This term IFS, as used in this manual, refers to the integrated use of the KI 256 attitude indicator and flight director, the KCS 55A compass system (HSI), and the S-Tec 55 autopilot system. Navigation, heading, and attitude information are integrated with the basic gyroscopic instruments, i.e., the direction gyro (DG) and attitude indicator (AI). For example, flight director bars are integrated with the AI and provide visual commands for the pilot to follow throughout the various realms of flight. Similarly, heading, navigational course, and glideslope data are integrated into the HSI. This type of integration enhances situational awareness and instrument interpretation.

KI 256 Attitude Indicator and Flight Director (FD) – The attitude indicator is part of the vacuum system, which is discussed on page 7-34. The instrument is a two-gimbaled gyro and operates at about 25,000 RPM. The gyro provides information relating to movement around the pitch and roll axes. The tumble limits (gimbal stops) are set at 85° in both pitch and roll. The instrument cannot be caged or reset in flight. If the instrument is tumbled in flight it will give

unreliable indications and takes up to 30 minutes to self-erect and give proper indications. On the ground, a tumbled gyro can be reset in a few minutes by stopping and starting the engine.

DRAWING OF THE KI 256 FLIGHT DIRECTOR



(Figure 7 - 7)

Attitude Indicator – The roll is indicated by displacement from a fixed white index at the top of the instrument. The displacement indications range left and right between 0° and 90° with major indexes of 30° and minor indexes of 10° between the 0° to 30° ranges. Roll is also indicated by the relationship between the delta figure in the foreground and horizon-like display in the background. The background horizon display is a painted disc with a white horizontal line through the diameter. The upper portion of the disc is blue to represent the sky and the lower ground portion is brown. Pitch is indicated by displacement of the fluorescent delta above and below the horizon line. The tip of the delta shows the position of the airplane's nose relative to the horizon. There are white lines above the horizon line indexed in increments of 5° with a label at the 10° and 20º points.

KI 256 Flight Director – The flight director portion of the unit is essentially provided by the yellow, triangular command bars, which touch each side of the delta. This is sometimes referred to as a single-cue flight director. The command bars move up and down together or individually, depending on the action commanded. For example, if the airplane is on an ILS approach and above the glideslope, both command bars will move down, commanding a descent. The pilot then changes the attitude of the airplane so the command bars are aligned with the delta. The command bars are scaled to the amount of change needed. If a large change is needed, the unit will command a larger adjustment and then incrementally reduce it as the desired target is approached.

The KI 256 is part of the Bendix/King KFC 200 system. However, the annunciator and select switch shown in the *Pilot's Guide for the King KAP/KFC 200 Flight Control Systems* are not included. The select switches on the autopilot unit and the autopilot annunciator above the flight director are substitutes for these Bendix/King items.

Autopilot/Flight Director Interface – Data for the flight director command bars (FDCB) are supplied by the S-Tec 55 autopilot computer, which is turned on through the autopilot master switch. See Section 9 for more information about the S-Tec 55 autopilot. Heading, navigation, climb/descent, and approach commands are all controlled by input to the autopilot control unit. In the FD mode, the autopilot is on but does not control the airplane. Instead, computer outputs, which were previously sent to the autopilot servos, are sent to the command bars of the flight director. Once mastery of the S-Tec 55 autopilot is achieved, a pilot should have little difficulty programming flight director commands. With the autopilot on, the command bars are made active by pressing the heading mode button on the autopilot and either the altitude button or vertical speed button.

The elevation of the delta is mechanically adjustable for parallax using the setscrew near the four o'clock position of the faceplate. However, a trained avionics technician must do this since the command bars must also be electronically adjusted to correspond with the location of the delta.

Pilot's Guide – A Bendix/King publication, *Pilot's Guide for the King KAP/KFC 200 Flight Control Systems*, is included as part of the *Pilot's Operating Handbook* and *The FAA Approved Flight Manual* and is the primary source document for operation and use of the system. The KFC 200 Flight Control System enhances and simplifies navigational and instrument approach operations. After reviewing *Pilot's Guide for the King KAP/KFC 200 Flight Control Systems,* pilots unfamiliar with its operation should have little difficulty using the system.

Altimeter – The altimeter is part of the pitot-static system, which is discussed on page 7-33. The instrument measures the height above sea level and is correctable for variations in local pressure. The pressure source for the instrument is from the static air vent. An aneroid or diaphragm within the instrument either expands or contracts from changes in air pressure, and this movement is transferred, through a series of mechanical linkages, into an altitude reading. Adjustments for variations in local pressure are accounted for by setting the station pressure (adjusted to sea level) into the pressure adjustment window, most commonly known as the Kollsman Window. The altimeter has two Kollsman Windows. The window in the three o'clock position permits settings in inches of mercury (labeled inches Hg.). The one in the nine o'clock position is calibrated for an equivalent value in millibars (labeled mb). The adjustment knob for these two windows is at the seven o'clock position on the dial.

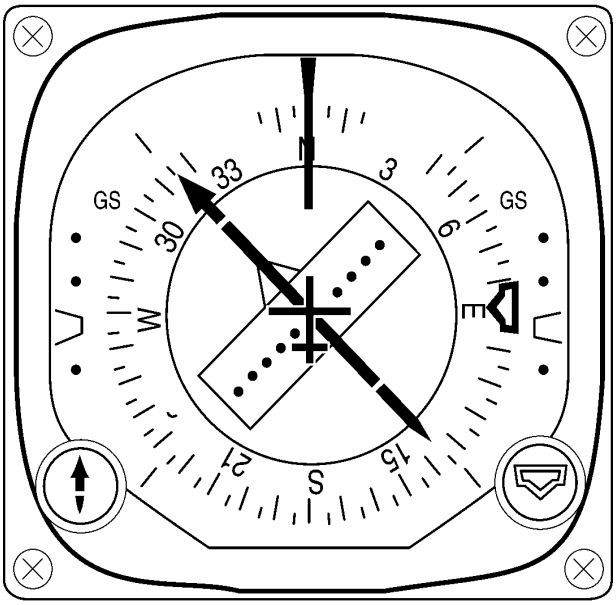
Optional Instrument – This space on the flight instrument panel is reserved for an optional instrument. A discussion of all optional equipment is included in Section 9.

Turn Coordinator – The turn coordinator is electrically powered and protected by a three-amp circuit breaker. The instrument has a single gimbaled, electrically driven gyro with the stationary axis of the gyro aligned relative to the longitudinal axis of the airplane, but tilted at a 37° angle. This type of arrangement provides information about movement around the vertical or yaw axis of the airplane. Tilting the gyro also allows the instrument to indicate a wing down condition, even when the airplane is not in a turn. Moreover, this design limits or dampens adverse yaw indications. The instrument is designed to measure the rate of yaw rather than relative change.

The instrument contains a rear view silhouette of an airplane that pivots at the center of the dial. When the wings of the silhouetted airplane are aligned with the horizontal white marks at the three and nine o'clock positions, the airplane is not turning and the wings are level. A standard rate turn (two minutes to change 360°) left or right is made by placing the left or right wing of the silhouette airplane on the left or right marks below the horizontal white marks. The quality of the turn is indicated by the inclinometer commonly referred to as "the ball." Under normal turning conditions, the ball should remain in the center of the race (the tube that contains the ball). The instrument provides no pitch information, and a red flag will appear above the right wing of the silhouette airplane if the instrument is without power.

KCS 55A Compass System – The KCS 55A system consists of four basic components, (1) the panel mounted KI 525A Horizontal Situation Indicator (HSI), (2) a magnetic slaving transmitter, (3) a directional gyro, and (4) the panel mounted KA 51B Slaving Control and Compensator Unit.

DRAWING OF THE KCS 55A FLIGHT DIRECTOR



(Figure 7 - 8)

Specifications – The instrument is an electrically driven dual-gimbaled gyro that spins at about 24,000 RPM. The instrument provides information about the airplane's relative change in heading. The tumble limits are set at 70°, and reliable operations have been demonstrated up to 55° in both the pitch and roll axes. If the HSI is tumbled, it can be reset by setting the slave control to the free position and toggling the spring-loaded compensator switch clockwise or counterclockwise, as appropriate. The compensator switch merely replaces the heading adjustment knob that is on the older, traditional gyros that are not slaved.

The directional gyro of the KCS 55A consists of a compass card with the top view of an airplane silhouette superimposed over the center of the dial. A pointer at the top of the card indicates the heading of the airplane. Pointers are placed on the compass card at 45° increments. Before takeoff, ensure that the KA 51B Slaving Control and Compensator switch is set to the *slaved* position. Also check that the magnetic compass and the reading on the HSI compass card are approximately the same. The KCS 55A compass system gyro is normally adjusted automatically to the KMT 112 magnetic slaving unit located in the wing.

HSI – The system is built around the KI 525A HSI pictured on the left side in (Figure 7 - 8). This instrument integrates heading, navigation, and instrument approach information into a single display unit. The unit is mounted in the flight instrument panel below the attitude indicator and replaces the conventional directional gyro (DG). The vertical panel mounted KA 51B Slaving Control and Compensator Unit is located in the engine instrument panel above the manifold pressure/fuel flow gauge and shown on the right side of (Figure 7 - 8). The magnetic slaving transmitter and directional gyro are mounted in a special avionics compartment, aft of the baggage area, below the hat rack. The access door is beneath the carpeting in the forward portion of the hat rack floor. The KMT 112 slaving transmitter is located near the left wingtip.

If the HSI provides inconsistent or erratic information, the problem is most likely associated with the KMT 112 magnetic slaving unit. The HSI can still be utilized by placing the slaving switch to the free position; however, the compass will need to be adjusted to the magnetic compass about every 15 minutes through use of the spring-loaded compensator switch.

Pilot's Guide – A Bendix/King Compass System *Pilot's Guide KCS 55A* is included as part of the *Pilot's Operating Handbook* and *The FAA Approved Flight Manual* and is the primary source document for operation and use of the system. The KCS 55 system enhances and simplifies navigational and instrument approach operations. After reviewing the *Pilot's Guide KCS 55A,* pilots unfamiliar with the operation of an HSI should have little difficulty learning the system.

Vertical Speed or Velocity Indicator (VSI or VVI) – The vertical speed indicator is part of the pitot-static system, which is covered in the next part of this section. Flow restricted static air is supplied to the inside of the instrument case while unrestricted air is sent to the inside of a diaphragm within the instrument case. The momentary pressure differential causes the diaphragm to expand or contract, and this movement is transferred into a rate of altitude change. The VSI indicates the rate of altitude change in feet per minute and ranges up and down from 0 to 4000 feet with major-labeled increments of 1000 feet. Between 0 and 2000 feet the minor increments are 100 feet, and between 2000 and 4000 feet the minor increments are 250 feet.

Navigation Indicator Head – The final area on the instrument panel is for the navigation display. This area in the panel will contain the MD200-306 navigation indicator. The use of the MD200-306 indicator is covered in avionics portion of this section.

HOUR METER

General – The hour meter is located on the right knee bolster, next to the power point and ELT remote switch. Two conditions are required for the hour meter to operate. The airplane must have an indicated speed of approximately 60 knots to activate the air switch, and oil pressure must be present at a sufficient level to activate the oil pressure switch. There are some airplanes that only use an air switch to activate the hour meter. The oil pressure switch is integrated to preclude inadvertent operation of the hour meter when the airplane is secured on the ground during extremely high wind conditions.

The hour meter will run even if the master switch is turned off during flight operations. The hour meter is provided to record time in service, which is the basis for routine maintenance, maintenance inspections, and the time between overhaul (TBO) on the engine and other airplane components. It is possible to record the approximate flight time using the FT function on the Davtron voltmeter/OAT/clock, which is discussed on page 7-25.

Applicability – The above general discussion is applicable to airplane serial numbers 40015 and above. On airplane serial numbers 40004 to 40014, the hour meter is operated anytime there is sufficient oil pressure to activate the oil pressure switch, which is basically anytime the engine is operating. No air switch is installed. All aircraft may be retrofitted with the air switch.

PITOT-STATIC SYSTEM

The pitot-static system, as the name suggests, has two components, ram air from the pitot tube and ambient air from the static air vent. The amount of ram compression depends on air density and the rate of travel through the air. The ram air, in conjunction with static air, operates the airspeed indicator. The static system also provides ambient uncompressed air for the altimeter, vertical speed indicator, and the blind encoder that is integrated with the airplane's transponder. (See page 7-28 for a discussion of the static system instruments.)

The pitot tube is located in the pitot housing on the right wing of the airplane, and the static air vent is on the right side of the fuselage between the cabin door and horizontal stabilizer. The pitot housing contains a heating element to heat the pitot tube in the event icing conditions are encountered. The heating element is protected by a 10-amp circuit breaker, which is located in the cockpit circuit breaker panel. If the normal static source becomes blocked, an alternate static source, which uses pressure within the cabin, can be selected. The alternate static source is located on the pilot's knee bolster, next to the left dimmer switch. To access the alternate static source, rotate the knob clockwise from the NORM to the ALT position.

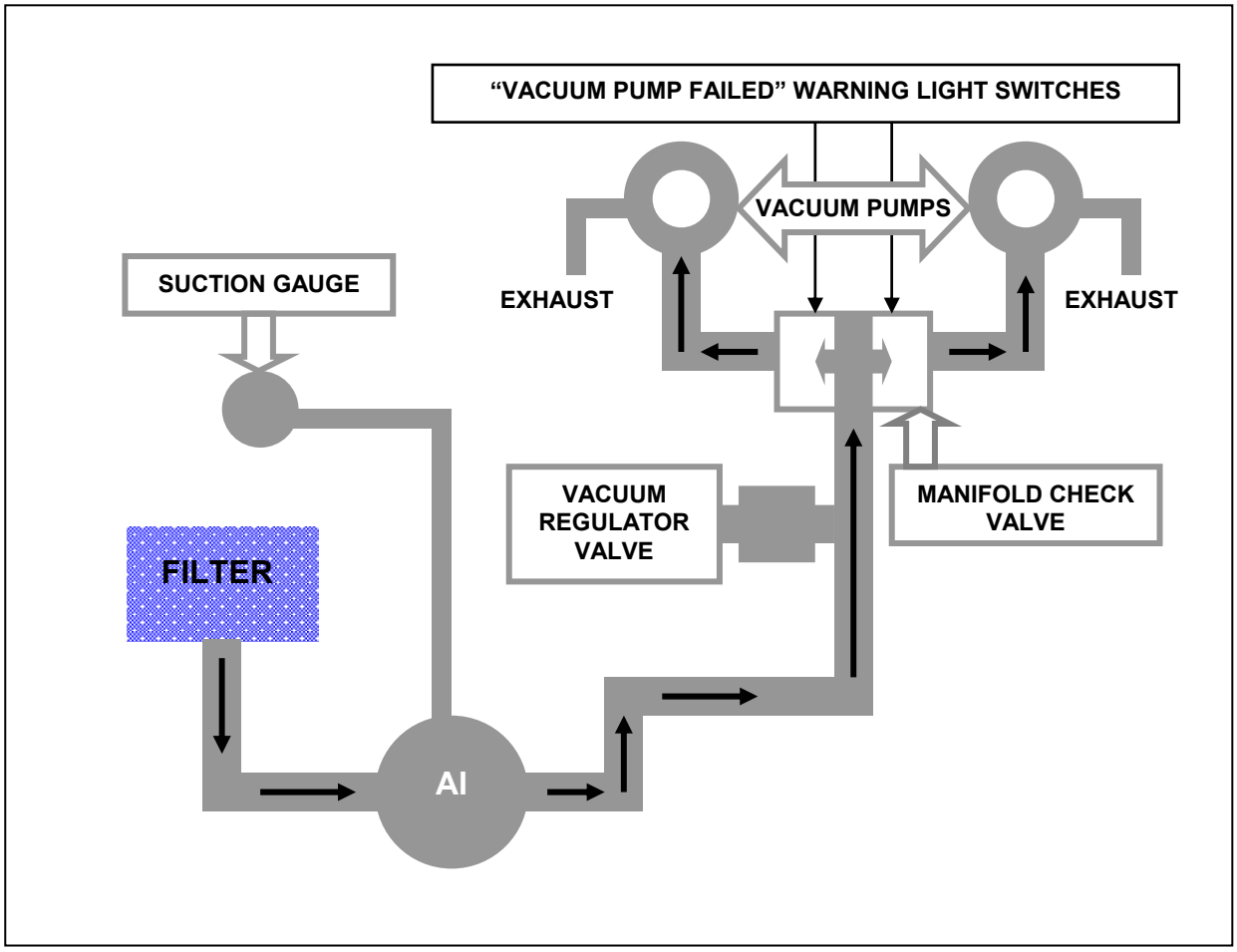
ENGINE RELATED SYSTEMS

VACUUM SYSTEM

The airplane is equipped with two engine-driven vacuum pumps that provide high velocity airflow to drive the gyros in the attitude and heading indicators. Air moves through the system and over vanes on each gyro, which produces a high-speed rotation, more than 24,000 RPM. Either pump produces sufficient vacuum to operate both instruments in the event one of the pumps should fail. If this happens, a message in the annunciator panel will illuminate to indicate which pump is inoperative. Both vacuum pumps must be installed and operating to operate in IFR conditions. Any inoperative pump or other component of the system must be replaced prior to the next flight.

The drawing in (Figure 7 - 9) shows the direction of airflow through the system. Air is drawn in through the air filter by the two engine driven vacuum pumps and routed to the attitude indicator (AI). The air passes through the indicator and is vented overboard. A suction gauge attached to the attitude indicator displays the system's relative pressure (negative), normally between 4.5 to 5.2 inches Hg. of vacuum. Since the airplane is equipped with an HSI that is electrically operated, air is only routed through the attitude indicator.

VACUUM SYSTEM DIAGRAM



(Figure 7 - 9)

To account for fluctuations within the system, the suction produced by the two engine driven pumps is well in excess of what is required to operate the two gyros. The suction pressure within the system is kept constant by the pressure regulator valve that draws air from an alternate source as necessary to maintain 4.5 to 5.2 inches Hg. of vacuum within the system. If either pump should fail, the manifold shuttle valve closes the line on the failed side, which ensures positive flow to the operating side.

It is important to note that it is possible to have normal suction readings with a non-functioning system. If the air filter is clogged and no air is drawn through the instruments, the suction pressure within the system is still maintained at prescribed levels by the vacuum regulator valve. In this situation, the system would first build 4.5 to 5.2 inches Hg of suction and then draw alternate air via the vacuum regulator valve. This condition is approximately analogous to sucking through a straw that is sealed in one end. While there is suction pressure inside the straw, there is no airflow through the straw.

FUEL SYSTEM

The fuel system has two tanks that gravity feed to a three-position (Left, Right, and Off) fuel selector valve located in the forward part of the armrest between the pilot and copilot seats. The fuel flows from the selected tank to the auxiliary fuel pump and then to the strainer. From this point it goes to the engine-driven pump where, under pressure, it is sent to the throttle/mixture control unit and then on to the fuel manifold valve for distribution to the cylinders. Unused fuel from the continuous flow is returned to the selected fuel tank. A pressure gauge on the metered side of the fuel manifold valve measures system pressure and displays both the fuel pressure and the equivalent fuel flow reading on the same gauge. The diagram in (Figure 7 - 10) shows a general layout of the fuel system for aircraft S/N 40004 to 40079. The diagram in (Figure 7 - 11) shows a general layout of the fuel system for aircraft S/N 40080 and on.

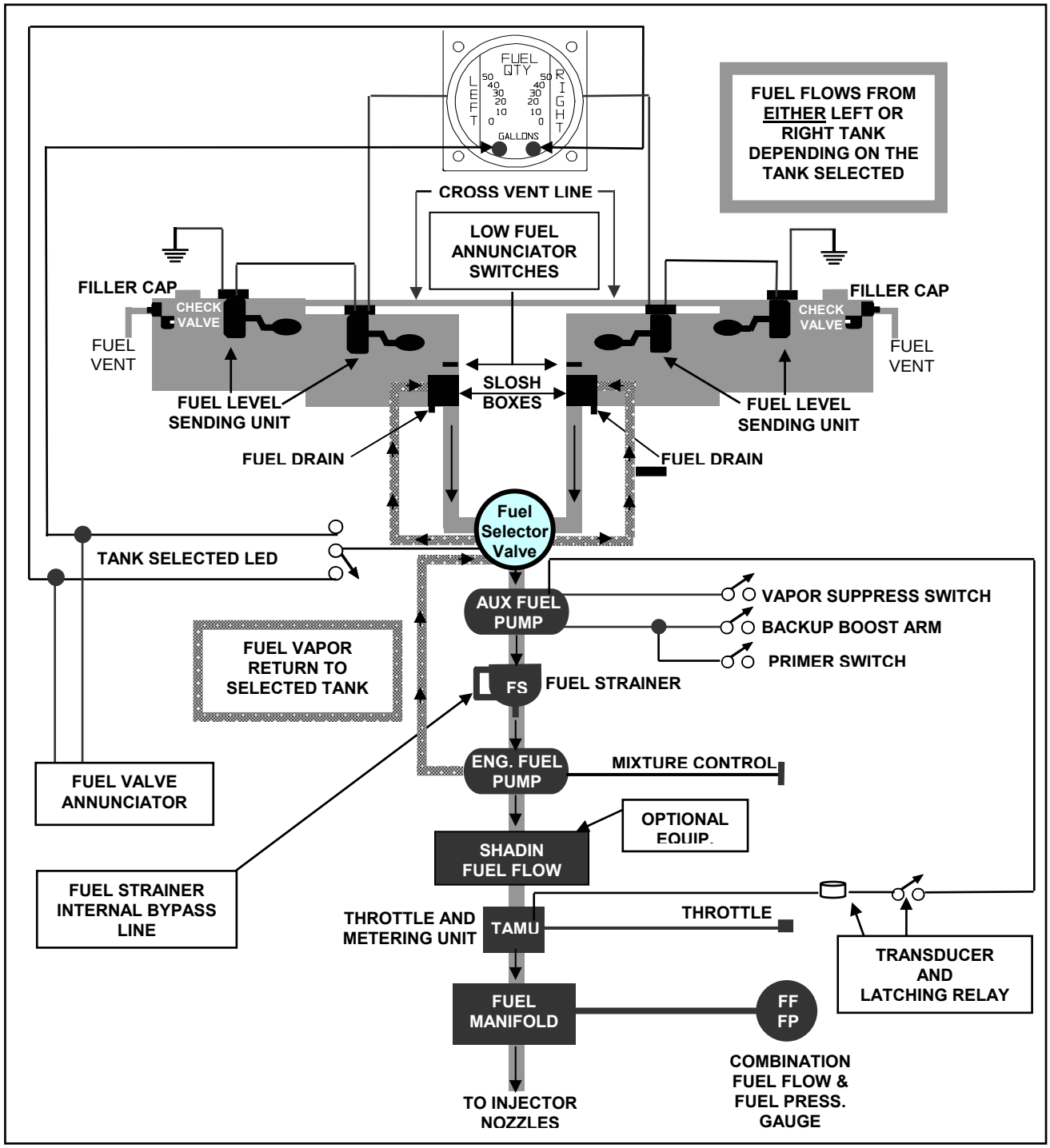
Each fuel tank contains a slosh box near the fuel supply lines. A partial rib near the inboard section of the fuel tank creates a small containment area with a check valve that permits fuel flow into the box but restricts outflow. The slosh box is like a mini-fuel tank that is always full. Its purpose, in conjunction with the flapper valves, is to ensure short-term positive fuel flow during adverse flight attitudes, such as when the airplane is in an extended sideslip or subject to the bouncing of heavy turbulence.

Fuel Quantity Indication – The airplane has integral fuel tanks, commonly referred to as a "wet wing." Each wing has two internal, interconnected compartments that hold fuel. The wing's slope or dihedral produces different fuel levels in each compartment and requires two floats in each tank to accurately measure total quantity.

The floats move up and down on a pivot point between the top and bottom of the compartment, and the position of each float is summed into a single indication for the left and right tanks. The positions of the floats depend on the fuel level; changes in the float position increases or decreases resistance in the sending circuit, and the change in resistance is reflected as a fuel quantity indication. The indicators are powered by the airplane's electrical system, protected by a two-amp circuit breaker, and will not operate with the master switch turned off. Please see page 7-22 for data on the fuel gauges.

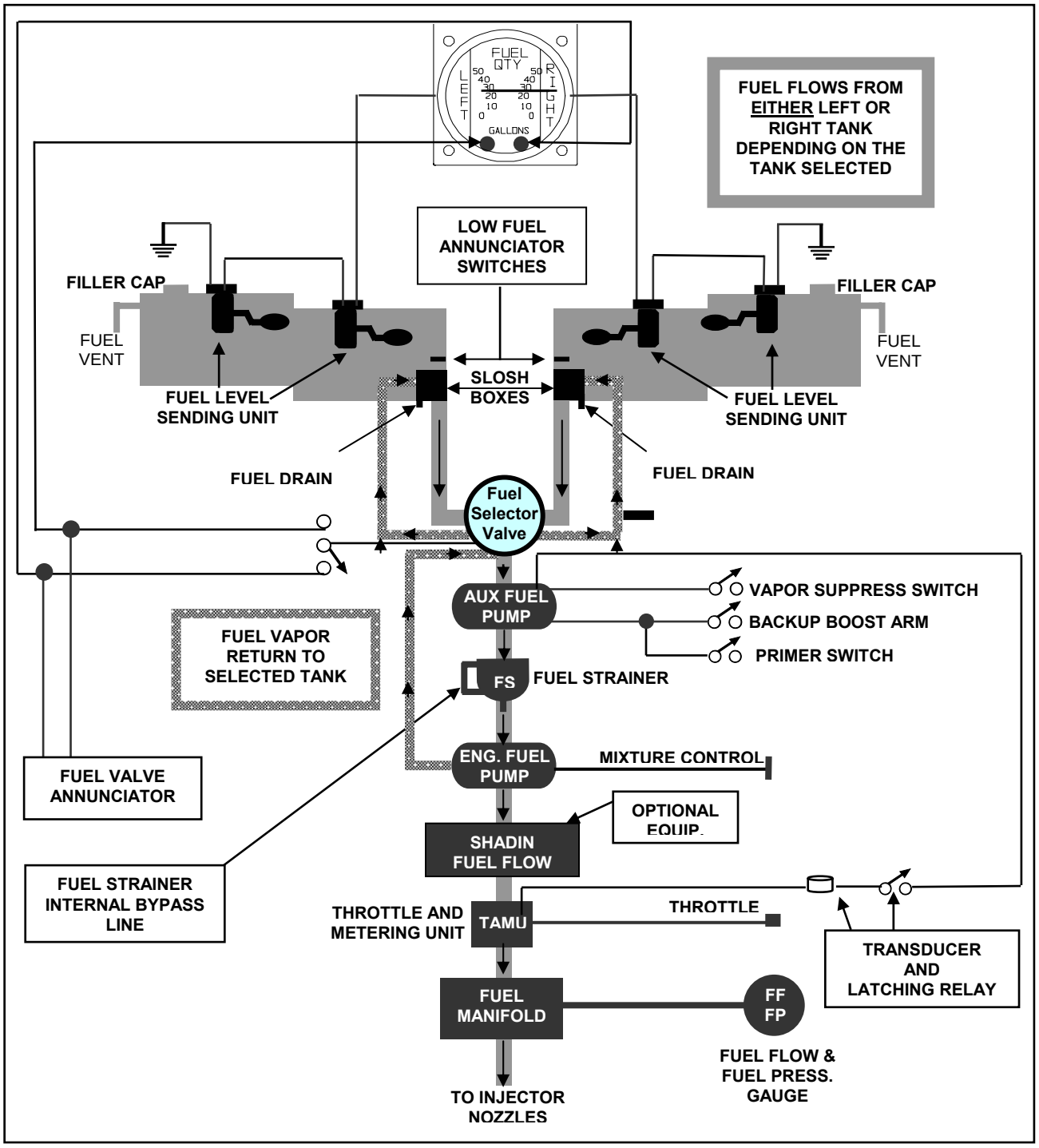
The pilot is reminded that the fuel gauges are approximate indications and are never substitutes for proper planning and pilot technique. Always verify the fuel onboard through a visual inspection, and compute the fuel used through time and established fuel flows.

FUEL SYSTEM DIAGRAM (AIRCRAFT S/N 40004 TO 40079)



(Figure 7 - 10)

FUEL SYSTEM DIAGRAM (AIRCRAFT S/N 40080 AND ON)



(Figure 7 - 11)

Fuel Selector – The fuel tank selector handle is between the two front seats, at the forward part of the armrest. The selector is movable to one of three positions, Left, Right, and Off. The fuel tank selector handle is connected to a drive shaft that moves the actual fuel valve assembly, which is located in the wing saddle. Moving the fuel tank selector handle applies a twisting force to move the fuel selector valve. Sometimes, to overcome the resistance to the sloping left and right detents, fractionally raising the fuel selector handle will make it easier to move.

When the fuel tank selector handle is moved to a particular position, positive engagement occurs when the fuel selector valve rests in one of the three available detents, Left, Right, and Off. Rotating the handle to the desired tank position changes the left and right tanks; initially, a small amount of additional pressure is required to move the valve out of its detent. A spring-loaded release knob in the selector handle prevents inadvertent movement beyond the right and left tank positions. To move to the Off position, pull up on the fuel tank selector, and rotate the handle until the pointer is in the Off position and the fuel valve is seated in the detent. To move the handle from the Off position to the left of right tank, pull up on selector, and rotate the handle to the desired tank.

When a tank is selected and the selector is properly seated in its detent, one of two green lights on the left and right side of the fuel gauge will illuminate to indicate which tank is selected. If a tank is selected, and a green light is not illuminated, then the selector handle is not properly seated in the detent. In addition, if the fuel selector is not positively seated in either the left or right detent, or is in the Off position, a red FUEL VALVE light indication is displayed on the annunciator panel.

Fuel Low Annunciators – There is a separate system, independent of the fuel quantity indicators, which displays a low fuel state. A fuel level switch in each tank activates a L LOW FUEL or R LOW FUEL light on the annunciator panel when there is less than 8 gallons (30 L) of usable fuel remaining in that tank. The fuel warning light has a 30 second delay switch, which limits false indications during flight in turbulent air conditions. Please see page 7-24 for data on the annunciator panel.

Fuel Vents (Aircraft S/N 40004 to 40079) – There is a ventilation source for the fuel tank in each wing. The vents are wedge-shaped recesses built into the access panel. They are located under the wing approximately five feet inboard from the wing tip and positioned to provide positive pressure to each tank. The vents should be open and free of dirt, mud and other types of clogging substances. The tanks are cross-vented with a line between the right and left tanks. When fuel expands beyond a tank's capacity, it is sent to the other tank or out the fuel vent if both tanks are full. A fuel vent check valve limits draining from the vents if the airplane is parked in a sloped area. However, an internal tank pressure of more than two to three psi will bypass the check valve and allow fuel to drain from the vents. The cross venting provides two vent sources for each tank, and both tanks are vented even if one of the fuel vents is clogged.

Fuel Vents (Aircraft S/N 40080 and on) – There is a ventilation source for the fuel tank in each wing. The vents are wedge-shaped recesses built into the access panel. They are located under the wing approximately five feet inboard from the wing tip and positioned to provide positive pressure to each tank. The vents should be open and free of dirt, mud and other types of clogging substances. When fuel expands beyond a tank's capacity, it is sent out the fuel vent if both tanks are full. An internal tank pressure of more than two to three psi will allow fuel to drain from the vents.

Fuel Drains and Strainer – The inboard section of each tank contains a fuel drain near the lowest point in each tank. The fuel drain can be opened intermittently for a small sample or it can be locked open to remove a large quantity of fuel. The gascolator or fuel strainer is located under the fuselage, on the left side, near the wing saddle. Open the accessory door in this area for access to the gascolator. There is a conventional drain device that operates by pushing up on the valve stem. There is an internal bypass in the strainer that routes fuel around the filter if it becomes clogged.

Backup Boost Pump, Vapor Suppression, and Primer – The auxiliary fuel pump is connected to two switches located in the rocker switch panel, just to the left of the engine controls. One switch is labeled BACKUP PUMP with red letters, and the other is labeled VAPOR SUPPRESS with amber letters. The vapor suppression switch is used primarily to purge the system of fuel vapors that form in the system at high altitudes or atypical operating conditions. The vapor suppression pump must be turned on before changing the selected fuel tank. If proper engine operations are observed, turn off the pump.
The positions on the backup pump switch are placarded with the terms BACKUP PUMP, ARMED, and OFF. The switch is normally in the ARMED position for takeoff and climb to cruise altitude and in the OFF position for cruise, descent, and approach to landing. If the engine driven pump malfunctions, and the backup pump is in the ARMED position, the backup fuel pump will turn on automatically when the fuel pressure is less than about 5.5 psi (±0.5 psi). This condition will also activate a red FUEL light in the annunciator panel. Please see an amplified discussion on page 3-15.

Primer - The primer is a push-button switch located next to the ignition switch in the master switch panel. Depressing the primer button activates the backup boost pump and sends raw gasoline, via the fuel manifold, to the cylinders. Since the fuel system is used for priming operations, the mixture must be rich and throttle partially opened for the primer to work properly.

Fuel Injection System – The engine has a continuous-flow fuel injection system. This system meters fuel flow as a function of engine speed, throttle position, and the mixture control. Metered flow is passed to air-bled, continuous flow nozzles at individual intake ports. The engine is equipped with a speed-sensing pump that delivers a nominal 28-psi discharge pressure at takeoff. The continuous-flow system permits the use of a rotary vane pump in place of the more complex plunger-type pump. A relief valve maintains optimum fuel flow and there is no need for an intricate mechanism for timing injection to the engine.

ENVIRONMENTAL CONTROL SYSTEM

The environmental control system (ECS) incorporates the use of an air-to-air heat exchanger, ram intake air, and an electric fan to distribute heated and outside air to various outlets within the cabin. The ECS essentially consists of two subsystems, heated air and the fresh air. Heated air is sent to floor vent system and defroster, and fresh air is ducted through the eyeball vents. The system demand affects the volume of flow to a particular vent. As more vents are opened, the airflow to each vent is decreased.

Airflow – Ram air enters through a hole in the front right portion of the engine intake and flows to either the heat exchanger (located on the right exhaust manifold) or the eyeball vents. Air to the heat exchanger, depending on the control settings, is mixed with outside air in the heater box. The air next passes through a fan unit before entering the distribution system. Operating the single speed fan will increase the airflow through the system (not including the eyeball vents). A diagram of the ECS system is shown in (Figure 7 - 12).

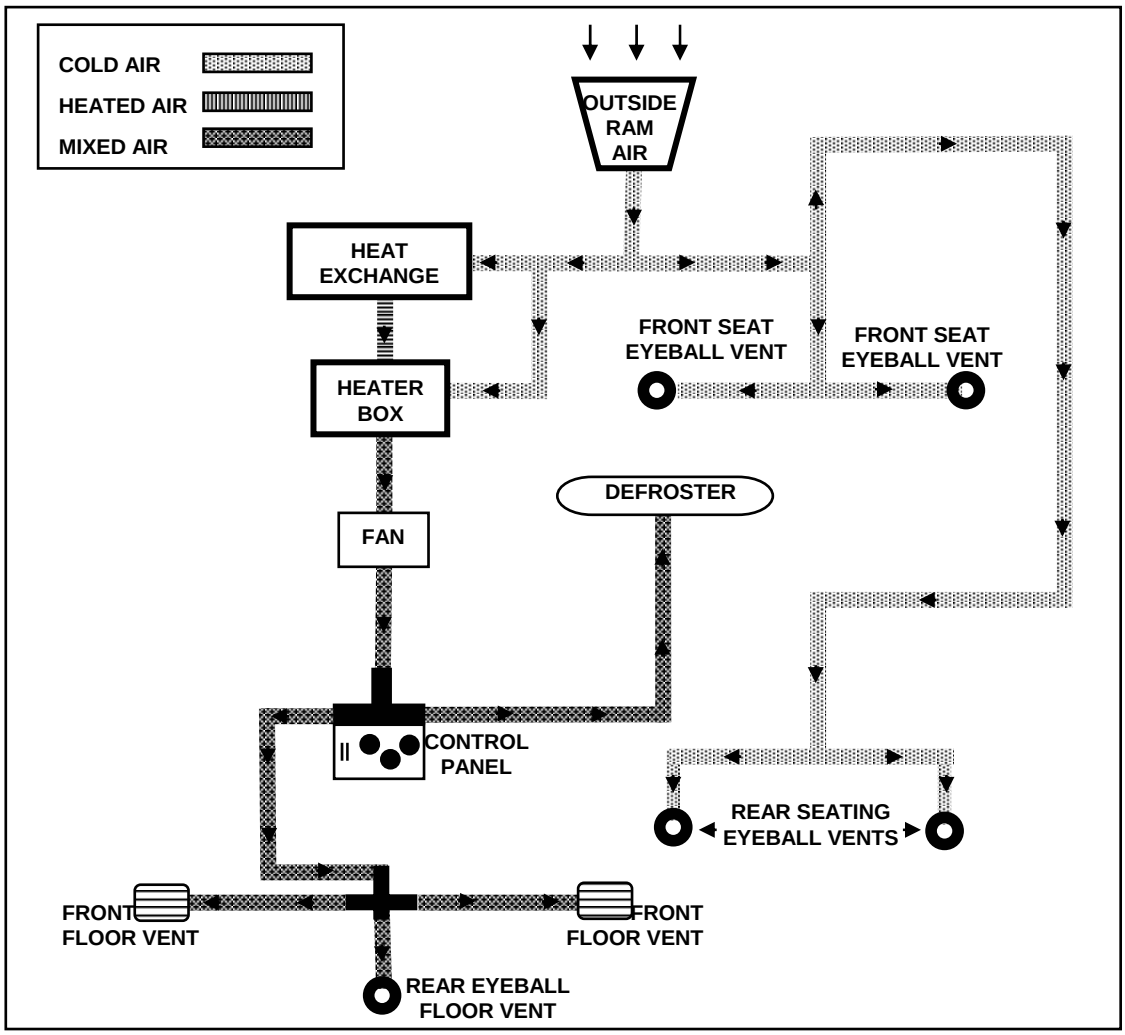
Floor Vent System – The floor vent system provides mixed air to vents under both knee bolsters in the front seat area and to two eyeball vents in the back lower portion of the front seat center storage console. Rotating the vents clockwise and counterclockwise controls the airflow to the rear floor eyeball vents, while the front vents have fixed grates. The temperature and floor air control knobs control the temperature of the air and the amount of airflow. Moving the knobs clockwise increases the temperature and volume of the air. Additional airflow is provided by operating the ECS fan, which is activated by a rocker-type switch on the left side of the panel. In

flight, under most conditions, the ram air provides sufficient airflow and use of the fan is unnecessary. However, the fan is useful for ground operations when the ram air source is limited.

Defrosting System – The defrosting system is operated by adjustment of the Defrost Air Knob in the ECS panel. Turning the knob clockwise will increase the airflow to the windshield. The temperature of the defrost air is controlled by the same center knob that controls the floor air system.

Individual Eyeball Vents – Outside, unheated ram air is ducted to the eyeball vents. Individual eyeball vents are located at each of the four seating positions. The pilot's vent is in the engine instrument panel, and the copilot's vent is positioned in a similar location on the right side panel. The two rear vents are behind the left and right cabin doorsills. Each vent is adjustable in terms of airflow volume and direction. Turning the adjustment ring on the vent counterclockwise opens the vent and increases airflow; turning the vent clockwise closes the vent and decreases airflow. In most situations, the eyeball vents are for fresh air, and the floor vents are for heated air. On warmer days, during taxi operations, some additional circulation is available from the floor vent system by operating the cabin fan with the heat control set to the lowest setting.

ENVIRONMENTAL CONTROL SYSTEM DIAGRAM



(Figure 7 - 12)

Standby Battery – The valve that controls the air temperature selected, from off to full, is operated by an electric servomotor mounted on the control unit. In case of a total electrical

failure, in situations associated with an engine or cabin fire, the airflow must be turned off. If the electrical system fails or power is turned off, the pilot can close the airflow by activation of the standby battery. The standby battery switch is located on the light row (second row) of the circuit breaker panel. See details on activation of the standby battery on page 3-23.

ELECTRICAL AND RELATED SYSTEMS

ELECTRICAL SYSTEM

General Description – The airplane electrical system is designed to normally operate at 14.2 volts. Power is supplied by a 60-amp alternator (continuous rating), and storage is maintained by a 25 amp-hour (at a 20-amp discharge rate) lead-acid battery located in the engine compartment. The voltage regulator is designed to maintain ± 0.4 volts of the normal voltage. There is an alternator switch in the cockpit area that disconnects the alternator and stops the excitation. A red "Alt Out" light in the annunciator panel illuminates should the alternator become inoperative. At 16 volts output, an over voltage control will stop the excitation to the alternator. The airplane is equipped with a voltmeter that measures bus voltage and an ammeter that measures the charging or discharging of the battery.

The system has four distribution buses, a primary bus, an avionics bus, a battery bus, and a standby bus. Power is supplied to the primary distribution bus when the system master switch is turned on, and supplied to the avionics distribution bus when both the system master and avionics master switches are turned on. Items connected to the battery bus bypass the master switch and are powered directly from the battery. The standby bus is connected to a reserve battery and supplies essential power for emergency operations. Please refer to (Figure 7 - 13) for a diagram of the electrical system.

Master Switch – The system master switch is located in the master switch panel to the left of the rocker switch panel. The switch is a split-rocker design with the alternator switch on the left side and the battery switch on the right side. Pressing the top of the alternator portion of the split-switch turns on both switches, and pressing the bottom of the battery portion of the split-switch turns off both switches. The battery side of the switch is used on the ground for checking electrical devices and will limit battery drain since power is not required for alternator excitation. The alternator switch is used individually (with the battery on) to recycle the system and is turned off during load shedding. See the discussion on page 3-22.

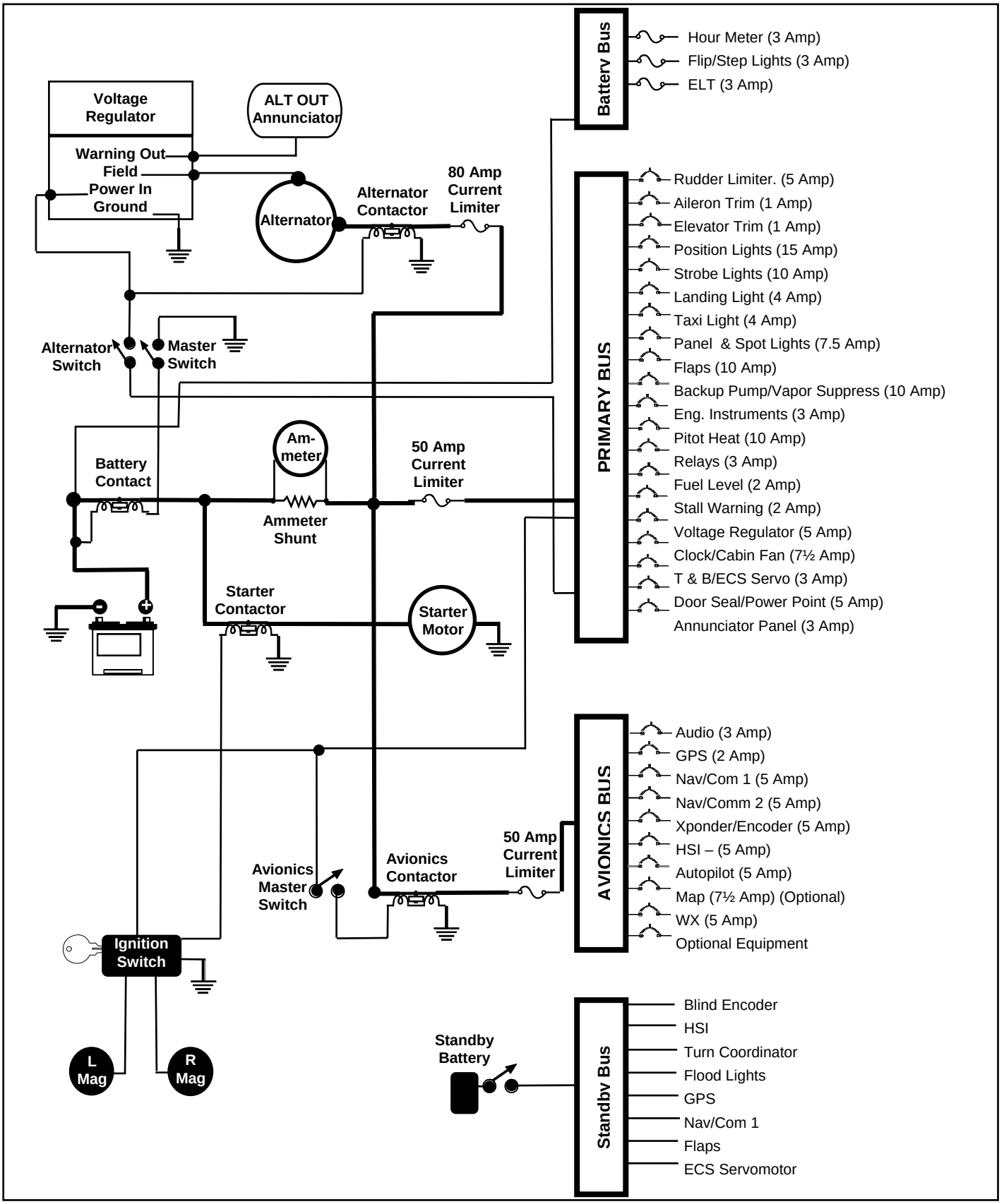
Avionics Master Switch – The avionics master switch is located in the master switch panel to the right of the system master switch. The switch is a rocker-type design and connects the avionics distribution bus to the primary distribution bus when the switch is turned on. The purpose of the switch is primarily for secondary protection of delicate avionics equipment when the engine is started. When the switch is turned off, no power is supplied to the avionics distribution bus.

Rocker Switch Panel – The rocker switch panel contains eight rocker-type switches that turn on various lights and devices. The labeling of each switch is shown in
(Figure 7 - 14). The number below each switch identifies the page number that contains the related discussion. The top of each rocker switch is engraved with an Off placard, which is only visible when the switch is turned off.

STANDBY BATTERY SYSTEM

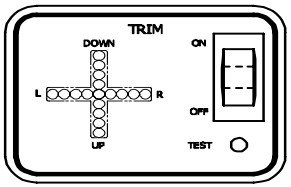
The standby battery switch is used in case of a total electrical failure. The guarded and wire-sealed switch is located on the light row of the circuit breaker panel. Breaking the copper wire on the switch guard, raising the switch guard, and depressing the push-button switch, activates the standby system. When the standby system is activated, electrical power from a standby 6-cell lithium battery pack is supplied to the essential lights, instruments, avionics, and electrical equipment. See (Figure 3- 5) on page 3-23.

ELECTRICAL SYSTEM DIAGRAM



(Figure 7 - 13)

PITOT HEAT	POSITION LIGHTS	STROBE LIGHTS	LANDING LIGHT	TAXI LIGHT	DOOR SEAL	VAPOR SUPPRESS	BACKUP PUMP
7-33	7-47	7-47	7-47	7-47	7-16	7-39	7-39



(Figure 7 - 14)

Once the standby system is activated, the equipment specified for each configuration shown in (Figure 3- 5) on page 3-23 will operate for at least 30 minutes. There is no monitor light to indicate that the system is operating, other than restoration of partial electrical power. However, the switch has a locking feature. When it is first engaged, it remains in the depressed position until pressed a second time.

The standby battery switch should only be used in case of a total electrical failure and under conditions that require standby power for the safe continuation of the flight. Once the standby system is activated and utilized, the battery pack must be replaced at the conclusion of the flight. In any event, the battery pack must be replaced every five years. Do not break the copper wire to test the system or for any other reason. If an unexplained broken sealing-wire is observed, inadvertent standby system activation is an important consideration, particularly if the switch is depressed. In either case, battery replacement is required. See page 3-24 for a discussion of standby battery emergency procedures.

AIRPLANE INTERIOR LIGHTING SYSTEM

The interior lighting system is one of the more sophisticated systems available for small airplanes. A good understanding of the following discussion is important to properly use all the features of the interior lighting system. The salient features of this system are summarized in (Figure 7 - 15), which begins on page 7-45.

Glare Shield Extension – A 22 in. (55.9 cm) wide extension panel is installed inside the top portion of the airplane's fixed glare shield. Grasping the curled edge in the center of the panel and pulling aft operates this extension panel. The extension adds about four additional inches to the fixed glare shield's length and eliminates nighttime instrument panel reflection on the windshield. This reflection is present when the pilot's seat is in some of the forward positions.

Flip & Access Lights – The flip-lights are rectangular shaped fixtures located in the middle of the overhead panel and in the baggage compartment. The lights bypass the system master switch and operate without turning on power to the system. Rotating or flipping the lens right or left turns on the two flip-lights. In the center position, they are used as part of the airplane's access lighting system.

When either main entrance door is unlatched, a switch in the door latching mechanism activates the two flip-lights and two lights that illuminate each entrance step. The access lights are on a ten-minute timer and turn off automatically unless reset by activating both main door-latching mechanisms when all the doors are closed.

This design has two advantageous features. First, opening either of the main cabin doors provides an immediate light source for preflight operations, passenger access, and baggage loading. Second, the flip-lights, when rotated either left or right, serve as emergency lighting in situations, which necessitate turning off the master switch. The only disadvantage is that the flip-lights can

inadvertently be left on, depleting battery power. To prevent this from happening, ensure the flip-lights are in the centered or flush position when securing the airplane at the end of a flight.

Overhead Reading Lights – There are three overhead reading lights, two in the front seat and one between the two backseat positions. Each light has its own switch and is on a swivel that can be adjusted to an infinite number of positions. The intensity of these lights is adjusted by moving the left thumb-wheel dimmer switch in the center of the overhead panel, near the windshield. The dimmer has an on-off switch at the extreme aft position of its rotation, and rotating the thumb-wheel forward increases the light intensity. The airplane's position lights must be on for the overhead reading lights to operate.

Instrument Flood Bar – There is a tube array of color-corrected lights inserted under the glare shield. This indirect light source complements the backlighting in each instrument and facilitates the use of adjustable instruments such as the true airspeed indicator, directional gyro, and navigational instruments. The intensity of the lights can be adjusted by moving the right wheel-type dimmer switch in the center of overhead panel, near the windshield. The dimmer has an on-off switch at the extreme aft position of its rotation, and rotating the thumb-wheel forward increases the light intensity. The airplane's position lights must be on for the instrument flood bar lights to operate.

Upper Instrument and Engine Panels – The instruments in the flight and engine instrument panels have backlighting, i.e., a small light within each instrument case that illuminates its dial. The left thumb-wheel switch between the pilot's legs on the knee bolster controls the dimmer for these lights. The dimmer has an on-off switch at the extreme down position of its rotation, and rotating the thumb-wheel up increases the light intensity. The airplane's position lights must be on for the upper instrument and engine panel lights to operate.

Lower Instrument Panel, Circuit Breaker Panel, and Rocker Switches – The lower instrument, circuit breaker, and rocker switch panels contain switches and controls that have backlighting. The lighting illuminates the placards on or next to the breaker, switch or control and the internally lighted engraved rocker switches. The right thumb-wheel switch between the pilot's legs on the knee bolster controls the dimmer for these lights. The dimmer has an on-off switch at the extreme down position of its rotation, and rotating the thumb-wheel up increases the light intensity.

Trim, Flaps, Fuel Tank Position, and Annunciator Panel (Press to Test PTT) – The test feature for these items is located in the lower right area of the trim panel, which is next to the rocker switch panel. Pushing the test button verifies the operation of all the LEDs associated with the trim, flaps, fuel tank position, and annunciator panel. The PTT is also used to verify operation of the rudder limiter and is discussed under a separate heading on page 7-47. When the test position is selected, all related LEDs illuminate in the bright mode. A light that fails to illuminate should be replaced.

The position light switch on the rocker panel controls the intensity of these lights. When the position lights are on, the trim, flaps, fuel tank position, and annunciator lights operate in the dim mode. When the position lights are off, the lights operate in the bright mode. The degree of luminance is set in at the factory and cannot be adjusted manually. In the daytime, during periods of reduced ambient light, the position lights can be turned on if the illumination of the LEDs is distracting.

SUMMARY OF INTERIOR LIGHTS AND SWITCHES

LIGHT	LOCATION OF LIGHTS	LOCATION OF SWITCH	REMARKS
Courtesy Lights	• Front and rear flip lights in overhead console • Exterior lights near the right and left entrance steps	♦ If all doors are latched, flip-light is activated by flipping the lens from the neutral position. ♦ If a door is unlatched, a switch activates flip-lights when the lens is in the neutral position.	▪ Door switch activates timer that turns off access lights after 10 minutes. ▪ Operates with master switch on or off
Overhead Swivel Lights	• Two overhead swivel lights in the front seat area • One centered swivel light in the rear seat area	♦ The left thumb wheel dimmer switch is in the overhead panel. ♦ Individual switch at each light	▪ Master switch and position lights must be on for the system to operate.
Glare Shield Flood Bar	• Color correct flood bar under the glare shield which lights the flight instruments and front panel areas	♦ The right thumb wheel dimmer switch is in the overhead panel.	▪ Master switch and position lights must be on for the system to operate. ▪ Part of the standby battery system
Upper Instrument Panel	• Provides backlighting for engine and flight instruments	♦ The left thumb wheel dimmer switch is in the knee bolster on the pilot's side.	▪ Master switch and position lights must be on for the system to operate.
Lower Inst. & Circuit Breaker Panels	• Provides backlighting for radios, switches, or placards next to switches, circuit breakers, and controls	♦ Right thumb wheel dimmer switch in the knee bolster on the pilot's side	▪ Master switch and position lights must be on for the system to operate.
Trim, Flaps, Fuel Tank, & Annunciator Panel	• The trim position LEDs are in the trim panel. • The Flap position LEDs are in the flap panel. • The fuel tank LEDs are on the fuel quantity gauge. • Annunciator LEDs are in the annunciator panel.	♦ The PTT feature is located in the trim panel, just to right of the rocker switch panel. LEDs are dimmed by operating the position lights.	▪ Master switch must be on for the system to operate.

(Figure 7 - 15)

Interior Light Protection – With the exception of the flip-lights, all interior lights are connected to the primary distribution bus and will only operate when the master switch is on. The light systems are protected by circuit breakers in the circuit breaker panel. See (Figure 7 - 13) for a listing of circuit breaker amperages ratings.

AIRPLANE EXTERIOR LIGHTING SYSTEM

Aircraft position and anticollision or strobe lights are required to be lighted on aircraft operated from sunset to sunrise. Anticollision lights, however, need not be lighted when the pilot in command determines that, because of operating conditions, it would be in the interest of safety to turn off the lights. For example, strobe lights shall be turned off on the ground if they adversely

affect ground personnel or other pilots, and in flight when there are adverse reflections from clouds.

The exterior lighting system includes the position lights, the strobe or anticollision lights, the landing light, and the taxi lights. These lights are activated through use of switches in the rocker switch panel. The light system is protected by circuit breakers in the circuit breaker panel. See (Figure 7 - 13) for a listing of circuit breaker amperage ratings.

Position and Anticollision Lights – The left and right position lights (red and green) are mounted on each wing tip. Each wing position light contains the required aft or rearward projecting white lights. The anticollision lights are on each wing tip and contained within the same light fixture as the position lights.

Taxi and Landing Lights – The taxi and landing lights are contained in the leading edge of the left wing. The outboard bulb in the light housing is the taxi light that provides a diffused light in the immediate area of the airplane. The inboard bulb is the landing light, which has a spot presentation with a slight downward focus. The taxi and landing lights are sized for continuous duty and can be left on for operations in high-density traffic areas.

STALL WARNING SYSTEM

Stall Warning – The aural stall warning buzzer in the overhead console is actuated by a vane-type switch located on the leading edge of the left wing. Under normal flight conditions, the angle of relative wind flow keeps the vane in the down position. The vane is connected to an electrical switch that is open under normal flight operations. When the airplane approaches its critical angle of attack, the relative wind pushes the vane up and closes the switch. The switch is set to activate approximately five to ten knots above the actual stall speed in all normal flight configurations.

Rudder Limiter – The rudder limiter, which is an integral part of the stall system, is designed to limit the normal full left rudder deflection of 17° ± 1° to only 11.5° ± 0.5°. The rudder limiter system is automatically armed in a relaxed position when the aircraft's electrical power is turned on. The system is activated when two conditions exist, (1) the airplane's stall warning is active, and (2) the engine manifold pressure is more than 12 in. of Hg. When the system is activated, a solenoid near the left rudder pedal moves a cam that physically limits the travel of the left rudder pedal. There is a time delay of approximately one second before the system is activated. This delay feature prevents inadvertent activation of the rudder limiter in turbulent air. A light located in the annunciator panel, triggered by a magnetic sensor located next to the rudder limiter cam acts as a visual indication of when the rudder limiter is engaged.

Two points need to be emphasized regarding the operation of the rudder limiter. First, if a left rudder deflection of greater than 11.5° exists before the stall warning is active with a throttle setting greater than 12 in. of Hg, the cam cannot engage. In addition, if a left rudder deflection of greater than 12° exists while the stall warning is active and before the throttle setting is greater than 12 in. of Hg, then the cam cannot engage when the throttle is advanced beyond 12 in. of Hg. Second, if the rudder limiter is activated and pressure is applied to the left rudder pedal so that the rudder limiter cam is engaged and then the conditions which caused the rudder limiter to activate cease to exist so that the rudder limiter action is no longer needed, then the pressure on the left rudder pedal must be released in order for the rudder limiter cam to disengage. In either of these two conditions the cam actuation does not override the rudder input. It should also be noted that should the manifold pressure gauge itself or the stall warning horn become

inoperative, the rudder limiter will still be functional provided that the stall warning vane is still operative.

Rudder Limiter Test – There are provisions for ground testing the rudder limiter during the preflight inspection. The purpose of the test is to verify operation of the manifold pressure transducer, the solenoid, and the cam next to the rudder pedal. While sitting in the pilot's seat with the master switch on and the engine off, depress the test button on the trim panel. When the test button is depressed, the pilot will hear and feel the solenoid near the left rudder pedal engage, the RUDR LMTR annunciator will illuminate, and left rudder travel will be restricted. When the operation is verified, release the test switch. The rudder limiter test switch is also used to test the operation of the trim, flap, annunciator panel, and fuel tank position LEDs. The pilot should remember that anytime these lights are tested, the rudder limiter will engage.

While the press to test feature verifies the individual operation of the system's basic components, it does not test the functionality of the system. For a function test of the system, turn on the master switch (engine off), and move the stall warning microswitch to the up position for two to three seconds. The aural stall warning will be heard immediately, followed by an audible "click" of the rudder limiter solenoid.

Rudder Limiter Fail-Safe Feature – The system is armed when the airplane's electrical power is turned on; however, all electronic and electrical switching are in the relaxed position. When the stall warning is active and manifold pressure is more than 12 inches of Hg, the system activates from this so-called "relaxed armed" position. If either of the two inputs to the system should fail, the rudder limiter will still operate. For example, if the manifold pressure transducer becomes inoperative, the rudder limiter will be activated by the sole input from the stall warning. Conversely, if the stall warning fails, the rudder limiter will be functional, provided the stall warning vane is operative, i.e., freely moves up and down.

Fail-Safe Test – The operating condition of the fail-safe system can be verified from time to time through use of a special ground testing procedure. With the master switch on and the engine off, pull the stall warning circuit breaker and have someone move the stall vane to the up position. The rudder limiter should engage even though there is no aural stall warning. Repeat the procedure with engine instruments circuit breaker pulled and the stall warning breaker reset. This time the rudder limit will engage with an aural stall warning, even though there is no manifold pressure indication.

Inadvertent Overriding of the Rudder Limiter – In flight, it is possible to inadvertently override the rudder limiter. The sequence of flight control input is the controlling factor. If full left rudder is applied while operating with the throttle set to more than 12 inches of Hg of manifold pressure and then the speed is reduced enough to activate the stall warning, the rudder limiter will attempt to engage. However, the deflected left rudder will limit movement of the cams and the system will be overridden until the left rudder pressure is released. The cams are spring-loaded and will engage when pressure on the left rudder pedal is released.

Stall Warning System (Electrical) – Operation of the stall warning system requires the master switch to be on since both the stall warning and rudder limiter are connected to the primary bus. Breakers in the circuit breaker panel protect both items. The stall warning is protected by a 2-amp circuit breaker and the rudder limiter is protected by a 5-amp circuit breaker. The two breakers are isolated from each other and failure of one system will not cause the other system to fail.

STANDARD AVIONICS INSTALLATION

The equipment described below covers both the basic avionics installation and some optional items. Other, optional STC installed avionics equipment is covered in Section 9 of this manual.

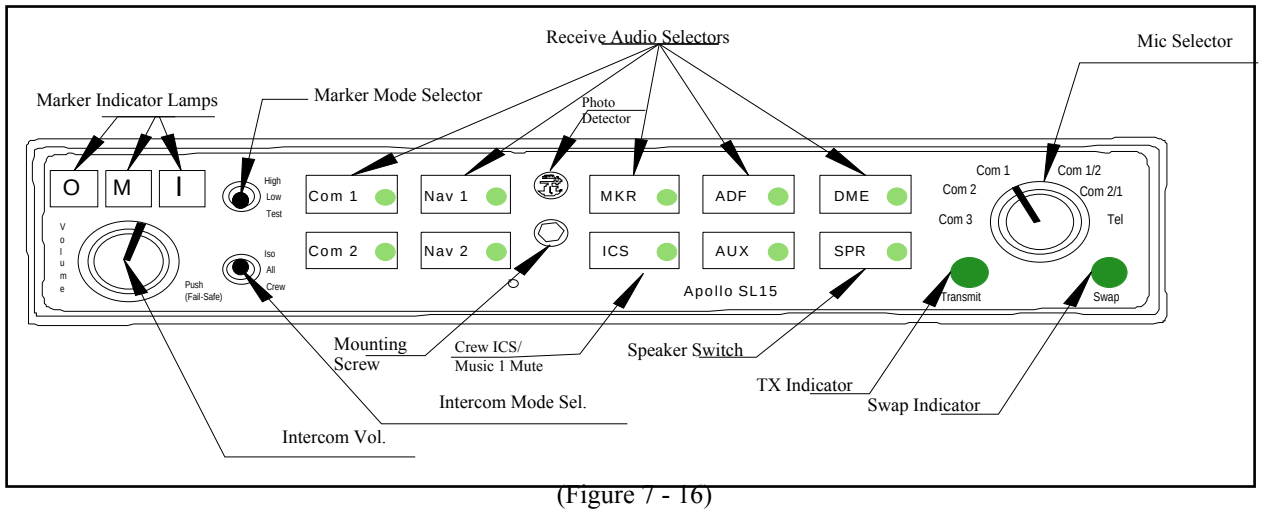
SL15-MS AUDIO AMPLIFIER

General – The Apollo SL 15MS Audio Selector Panel/Intercom System (ASPIS) is frequently referred to as the audio panel. The primary purpose of the panel is to control communication and navigation selections, intercom functions, and the marker beacons. In addition, the unit has provisions for two stereo entertainment inputs. The audio panel is located in the top of the radio rack panel assembly, and a drawing of the unit is shown in (Figure 7 - 16).

Microphone Selector Switch – The microphone selector switch is a rotary-type knob located on the right side of the audio panel. The unit has an automatic communications feature that automatically pairs the receiver with the selected transmitter. This permits selecting a desired transmitter (Com 1 or Com 2) without having to reselect the corresponding communication receiver button. The receiver selection is displayed to the left of the microphone selection switch in the ten button Audio Selector portion of the panel. As a particular transmitter is selected, a light in the respective com button is illuminated.

Transmitter Indicator – When either the pilot or copilot are transmitting, the green lamp associated with the Com that is being used to transmit will flash continuously as the PTT is depressed.

DRAWING OF THE SL15 STEREO AUDIO PANEL



(Figure 7 - 16)

Com Functions – When Com 1 is selected, the No.1 SL30 radio is selected. When Com 2 is selected, the No. 2 SL30 radio is active for communication. Com 3 can be utilized at a later time if a third communications transceiver is installed in the airplane, such as an HF unit. Note that there is not a dedicated Com 3 audio mode switch for monitoring. However, the AUX switch can be used for this function.

Split Com Modes – The unit has three split communications modes, Com1/Com2, Com2/Com1, and Tel. These functions allow the pilot and copilot to communicate simultaneously on two different radio frequencies. The left and right placement of the Com number can be thought of as

referring to the respective left and right seat positions. For example, with the Microphone Selector Switch set to Com1/Com2, the pilot can communicate on Com 1 while the copilot communicates on Com 2. This feature is useful when the pilot is in contact with ATC while the copilot is speaking to Flight Watch.

NOTE

Due to the nature of VHF communications signals and the size constraints in general aviation aircraft, it is probable that there will be some bleed-over in the Split mode, particularly on adjacent frequencies. UPS Aviation Technologies makes no warranty about the suitability of Split Mode in all aircraft conditions. Split Mode does not turn off other (Nav, ADF, etc.) selected audio to the pilot. However, the copilot will only hear the selected communications receiver.

TEL Mode – The TEL position is for telecommunications and works when the system is interfaced to an appropriate approved wireless system, such as the AirCell® ACM2000. Placing the microphone selector in TEL position connects the pilot's microphone and headphones to the installed cell phone. Pressing the pilot's push to talk (PTT) function will automatically switch the pilot microphone selection to the Com 1 position and allow continued aircraft communications as well.

On/Off and Fail-Safe Feature – Unit power is turned on and off by pushing the volume knob. The SL15 has a fail-safe feature, which permits use of the audio panel even if it is turned off or loses power. While the unit will not have lighting and the intercom will be inoperative, communications can still be maintained on the pilot's side using the No. 1 Radio. The fail-safe feature is not activated on the copilot's side.

Audio Selector Buttons – There are 10 latching buttons in the Audio Selector that can be depressed and latched to monitor a particular receiver. Depressing and latching the button of the desired receiver makes that receiver active and illuminates the light on the face of the button. To deselect the receiver, push in on the button to unlatch it. If the light in the button is not illuminated, the receiver audio is not active. Remember, the volume control on the particular selected receiver determines the loudness, not the volume control on the audio panel.

1. **Com 1 and 2** – One Com is selected by the microphone selector switch, which lights the corresponding Com button. The annunciation light cannot be extinguished by pressing the latching switch. Depressing the Com latching switch monitors the Com not selected by the microphone switch.
2. **Nav 1 and 2** – The Nav 1 and 2 (navigation) button is used to receive audio information from VHF Omnidirectional Range (VOR) stations or an instrument landing system (ILS).
3. **Distance Measuring Equipment (DME)** – Depressing the DME button makes the audio active for an installed DME.
4. **Automatic Direction Finding equipment (ADF)** – Depressing the ADF button makes the audio active for an installed ADF.
5. **ICS Switch** – Pressing the ICS permits pilot/copilot communications when Com function is set to the split mode, i.e., Com 1/Com 2 or Com 2/Com 1. In split mode, the pilot and copilot are usually isolated from each other on the intercom, simultaneously using their respective radios. Depressing the ICS button in Split Mode will activate VOX intercom between the pilot and copilot positions. This permits intercommunication when desired between the crew. Pressing the ICS button again disables this crew intercom function.

6. **Auxiliary Button** – The AUX Button permits additional optional equipment such as a second ADF or DME.
7. **Marker Beacon Receiver** – The marker beacon receiver is located on the far left, top upper portion of the audio panel. There are three lights, blue (outer marker), amber (middle marker), and white (inner/airway marker), which give a visual and aural indication when the respective marker is crossed in flight. The MKR button in the audio panel must be depressed for the audio portion to function. There is also a marker beacon repeater indicator located in the flight instrument panel, above the artificial horizon. The repeater indicator must be functional for IFR operations using the marker beacon receiver.
    - The **High and Low sense switches** control the sensitivity of the marker beacon receiver. In the High position, the outer marker is received about a mile from the receiver. In the Low sense position, the airplane must be proximate to the marker beacon receiver to receive the aural and visual indication. Many pilots set the marker switch to the higher sensitivity for an advance indication of approaching the outer marker and then set the sensitivity to the lower level when the marker signal is received. Doing this will silence the tone and visual indication until the airplane is closer to the marker, giving the pilot a more precise indication.
    - Holding the three-position switch in the **Test position** applies voltage to all three marker lamps to indicate they are functioning. The TEST position is spring-loaded so that when the toggle switch is released, it returns to the LO SENS position. The photocell in the faceplate automatically measures ambient light conditions and dims the marker lights, the label backlighting, and the lights in the Audio Selector Buttons.
    - The aural portion of the marker is turned on and off by selecting and deselecting the "MKR" audio switch on the Audio Selector Panel. The markers do not have an automatic audio reset function, and if the audio for the markers is deselected, it stays off until reselected.
8. **Speaker Switch –** The "SPR" labeled latching button on the Audio Selector Panel is for turning the cabin speaker on and off. In the unlatched position, audio information is sent only to the headsets. If the button is pushed in and latched, the light in the button is illuminated and the selected audio information is sent to the headphones and the cabin speaker. However, in the split communications mode, the speaker is disabled, even if the "SPR" button is selected. It is recommended that the speaker be disengaged when using the split mode.

Swap Function – The swap function is for remotely changing back and forth between from Com 1 to Com 2 through use of a momentary switch on the control stick. This option is not installed in the airplane. The owner or operator of the airplane may wish to have this feature installed by an authorized avionics technician.

Volume Control – The particular device selected, not the audio panel, controls the volume to the headset and cabin speaker. Moreover, the communication feature is always active even when an unrelated Audio Select Button is depressed. For example, if Com 1 is selected on the microphone selector switch, the Com 1 Audio Selector Button will automatically be selected, illuminated, and audio information will be sent to the headphones (and speaker, if selected). If Nav 2 is selected at the same time, both button lights (Com 1 and Nav 2) will be on. Depending on the volume setting of each unit, two sources of communications could be sent to the headphones and the cabin speaker.

Intercom – The intercom portion of the audio panel is located to the left of the Audio Select Buttons and contains a volume control, a Squelch control, and a three-position intercom selection

switch. The volume button controls the loudness of the intercom system only. Communication and navigation amplification is regulated by the volume controls on the radios.

The intercom system is voice actuated. When someone speaks, the voice generates a small current and activates the microphone switch. To prevent broken or clipped communication the squelch should be adjusted before each flight. With the engine running, set the VOX (Voice activated Relay) level by slowly rotating the Squelch Control Knob clockwise until noise from the engine is no longer audible. Make sure no one is speaking or creating noise while adjusting the squelch. It is probably best to monitor the system with the intercom select switch in the "All" position to verify that the system is noiseless. It is also recommended that unused headsets be unplugged to preclude extraneous background noise.

The Intercom Select switch can be set to three modes depending on the situation and pilot preference. The mode selected is indicated by the position of the switch in relation to the placard.

1. In the **"All" mode**, the intercom is linked to all seat positions; the pilot and passengers can talk to each other, everyone hears radio communications, and everyone hears music from Entertainment No. 1 (optional equipment). During any communication, the music volume decreases and then gradually increases back to the original level after communications are completed. This so-called "soft mute" mode is also selectable by pressing once on the volume control.
2. In the **"Crew" mode**, pilot and front seat passenger are linked together; they can communicate with each other and receive radio communications. The rear seat passengers are linked together and can talk to each other but cannot hear radio communications nor can they communicate with the pilot and front seat passenger. The pilot and copilot can hear music from Entertainment No. 1, and passengers can hear music from Entertainment No. 2 if installed by the owner or operator of the airplane. (The Audio Panel has the capability for two entertainment channels; however, access to Entertainment No. 2 is not available as an optional item.)
3. In the **"Iso" (Isolate) mode**, the pilot hears the radios, but is isolated from the intercom, while the front seat and rear seat passengers are on the same intercom loop but cannot hear radio communications. The front and rear seat passengers can hear music from the optional Entertainment No. 1 channel.
4. The above description of the various intercom modes is valid only when the Microphone Selector switch is set to Com 1 or Com 2. Anytime the selector switch is set to one of the three Split Modes, only the rear seat passengers have intercom functions.

Squelch Adjustment – No adjustment of the *IntelliVox*™ squelch control is necessary. Through three individual signal processors, the ambient noise appearing in all microphones is constantly being sampled. Non-voice signals are blocked. When someone speaks, only their microphone circuit opens, placing their voice on the intercom. The system is designed to block continuous tones; therefore, people humming or whistling in monotone may be blocked after a few moments.

For best performance, the headset microphone must be placed a minimum of ¼ inch away from your lips, preferably against them. It is also a good idea to keep the microphone out of a direct wind path. Moving your head through a vent air stream may cause the *IntelliVox*™ to open momentarily. This is normal. For optimum microphone performance, UPS Aviation Technologies, Inc. recommends installation of a Microphone Muff Kit from Oregon Aero (1-800-888-6910). This will not only optimize VOX performance, but will improve the overall clarity of all your communications.

Key Click Adjustment – It is possible to provide audible feedback when depressing any of the 10 pushbuttons of the SL15. The pushbuttons are not only mechanical to provide direct sun light readability, but with the key click enabled, the pilot can hear the action of depressing the pushbuttons. To enable the key click, depress the Com 1 and Com 2 buttons simultaneously for at least 3 seconds. To inhibit the function, again press the Com 1 and Com 2 pushbuttons simultaneous for at least 3 seconds. Once the function has been disabled or enabled, the SL15 will remember that mode until the pilot changes it. When the aircraft radios are audible at a particular position, that position will also hear the key click.

APOLLO GX50 GLOBAL POSITIONING SYSTEM (GPS)

General – The GPS is a United States satellite based radio navigational, positioning, and time transfer system operated by the Department of Defense. The system provides highly accurate position and velocity information and precise time on a continuous global basis to an unlimited number of properly equipped users. The system is unaffected by weather and provides a worldwide common grid reference system based on the earth fixed coordinate system. The GPS constellation of 24 satellites is designed so that a minimum of five are always observable by a user anywhere on earth. The receiver uses data from the best four satellites above its horizon, adding signals from one as it drops signals from another, to continually calculate its position.

The GPS receiver verifies the integrity of the signals received from the GPS constellation through receiver autonomous integrity monitoring (RAIM) by determining if a satellite is providing corrupted information. At least one satellite, in addition to those required for navigation, must be in view for the receiver to perform the RAIM function; thus, RAIM needs five satellites in view, or four satellites and baro-aiding to work. RAIM needs six satellites in view (or five satellites with baro-aiding) to isolate the corrupt satellite signal and remove it from the navigation solution. Baro-aiding is a method of augmenting the GPS solution equation by using a nonsatellite input source. Baro-aiding uses the pressure altitude corrected for the local barometric pressure setting to provide accurate altitude information to the GPS receiver.

The Global Positioning System, when receiving adequate and usable signals, can be used as a primary means of navigation in oceanic airspace and certain remote areas. GPS equipment may be used as a supplemental means of IFR navigation for domestic en route, terminal operations, and certain instrument approach procedures. This approval permits the use of GPS in a manner that is consistent with current navigation requirements. The system can be used as one of the required items for long-range oceanic navigation and as the only device for short-range oceanic routes that require one source of navigation.

PICTURE OF THE GX50 GPS

(Figure 7 - 17)

Subscription Updates – The GX50 GPS Navigation system in the airplane has a database that contains detailed information about waypoints, airports, VOR's, and NDB's, as well as the capability for 500 user-defined waypoints. The database is updated every 28 days and is revised by inserting a new database card into the GPS. The Nav/Data™ information is provided through an arrangement with Jeppesen Nav/Data™ Service and is available on a subscription basis. Contact UPS Aviation Technologies, Inc. at the address shown in the *GPS User's Guide* for more details.

Apollo GX50 User's Guide – The GX50GPS is limited to use for en route and non-precision approach IFR operations. An Apollo *GX50 User's Guide* is included as part of the *Pilot's Operating Handbook* and *The FAA Approved Flight Manual* and is the primary source document for operation of the airplane's GPS. To properly use all the features of the GX50 GPS requires considerable practice and study. However, the long-term benefits more than justify the time devoted to learning the system.

It is imperative that the GPS guide be studied at some length and that several hours of in-flight practice under VFR conditions occur before using the GPS for IFR operations. The GPS unit provides an extensive amount of flight, navigation and airport data, but there is a corresponding level of complexity. Two flight simulation functions are available for home study purposes. (1) There is a flight simulator mode preprogrammed into the GPS unit. The *Apollo GX50 User's Guide* contains procedures for removal of the GPS and using it in the home environment for training purposes. (2) The manufacturer of the GPS sells a CD ROM flight simulator program designed for the Windows 95/98 and NT operating systems.

Most of the documentation in the GPS user's guide is applicable to the GPS unit installed in the airplane. However, fuel/air information is limited to pressure altitude input from the Trans-Cal SSD 120 encoder. The other input details to the fuel/air data system such as temperature and fuel information are not integrated with the GPS. While the GPS is capable of processing this additional data and displaying items such as density altitude, outside air temperature, endurance, range, etc., this is not possible as the airplane is currently configured. If the owner or operator of the airplanes wishes to integrate these additional inputs, contact the GPS manufacturer for more information.

H14 GPS ANNUNCIATOR CONTROL UNIT (ACU)

The information displayed on the H14ACU is repeated on the face of the GX50 GPS. However, Federal Aviation Regulations require an installed and operating remote annunciator in the instrument panel for IFR operations. The panel contains six annunciator lights and two push buttons, NAV/GPS and GPS/SEQ. The following discussion assumes a basic understanding of the GX50 GPS. A drawing of the H14ACU annunciator is shown in (Figure 7 - 18) and a discussion of the features follows.

MSG (Message) Light – When the annunciator message (MSG) light on the upper left side of the remote indicator is illuminated, there is one or more new messages waiting for review. Pressing the message key on the installed GPS unit accesses the details of a message. The message will show information about the GPS system and may require pilot action. When the message light is on, the message(s) should be reviewed as soon as possible since some messages are associated with the system's integrity.

(Figure 7 - 18)

The message light also displays information, instructions, and input prompting during the en route and approach phases of the flight. As the airplane approaches an en route waypoint, or an initial or final approach fix (IAF and FAF respectively) the message light illuminates on the panel of the H14ACU. Pressing the message button on the GX50 will display information about the flight or direct the pilot to take certain actions.

NAV/GPS Annunciator and Button – Depressing the NAV/GPS latching button selects the GPS function when the button is locked in the depressed position. This also illuminates the GPS light to the left of the button. If the GPS light is on, information from the installed GPS unit is selected for display on the navigation indicator. When the latching button is out, the navigation function is selected and the NAV light will be illuminated. If the navigation light is on, the information from the SL30 is selected for display on the panel mounted navigation indicator. Repeated depressions of the switch will toggle the indications between the NAV and GPS modes.

APPR (Approach Transition) – This particular function permits using the GPS for non-precision instrument approaches. One difference between this mode and the en route mode is the integrity monitoring is set to a tighter level. In the en route mode, a full-scale reading of the CDI equals five miles from center to the left or right. In the approach transition mode the scale is one mile left and right. When the airplane is 30 nautical miles from the destination airport with an approach loaded in the GPS, a message will offer the pilot the option to enable the approach. When the approach is enabled through input to the GPS, the APPR light will illuminate to indicate the airplane is in the approach transition phase. The IAF is usually crossed within this 30-mile transition area.

ACTV (Approach Active) – When the airplane is within three nautical miles of the FAF, the ACTV light will start flashing. Within two miles of the FAF, the CDI sensitivity will change gradually from one mile to three tenths of a mile. As the airplane passes the FAF, the ACTV light will become steady and the OBS HOLD light will turn on.

The APPR ACTV mode is only entered through automatic engagement by the GX50 GPS. Once the airplane crosses the FAF, flight plan leg sequencing is suspended; hence, the OBS HOLD light is illuminated automatically. In this situation, the missed approach point (MAP) is the next waypoint. Once the airplane passes the FAF, depressing the GPS SEQ button will cancel the APPR ACTV and OBS HOLD indications. The mode can only be reengaged by flying a missed approach and returning to the FAF.

WARNING

Once the airplane has passed the final approach fix, the ACTV light must be on and steady. If the light is not on or does not stop flashing, do not continue the approach. Moreover, the blind altitude encoder/digitizer must be on and functioning properly for operations in the approach mode. See page 7-63 for a discussion of the Trans-Cal SSD 120 blind encoder/digitizer.

PTK (Parallel Track) – To avoid other air traffic, many pilots prefer flying a course parallel to a given airway but a few miles to the left or right. The GX50 can be programmed to fly parallel courses to most flight plans set into the GPS. When this particular feature is active in the GPS, the PTK light will illuminate and remain on during the period parallel tracking is in use.

GPS SEQ (GPS Sequencing) – The GPS sequencing switch is used to temporarily suspend the active flight plan. A repeated input to the spring-loaded GPS SEQ switch toggles the GPS in and out of the OBS HOLD mode. When the OBS HOLD light is on, the active flight plan is temporarily suspended. As discussed above, the OBS HOLD is automatically engaged after crossing the final approach fix during an instrument approach. There are other times during a typical VFR or IFR flight that the OBS hold function is useful. For example, under VFR conditions the pilot might want to do a few minutes of sightseeing along a particular route. During IFR operations, ATC might require holding at some en route location.

APOLLO SL30 NAV/COMM

Overview and Quick-Start Guide – The information that follows is excerpted from the *Apollo Model SL30 NavComm User's Guide* and is edited somewhat. The SL30 information in this AFM/POH is intended as a quick-start guide and must be supplemented with the 40± page user's guide, which is included as part of the AFM/POH.

(Figure 7 - 19)

Getting Started – The SL30 combines a 760-channel VHF communications transceiver with a 200-channel VOR, localizer, and glideslope receiver. Besides the traditional Nav/Comm features, the SL30 also provides automatic decoding of the Morse code station identifier for VOR/LOC, most-used frequency storage in memory, and built-in course deviation indicator. The SL30 can also monitor the standby Comm and Nav frequencies. When a localizer frequency is tuned and in the active window, the radio automatically tunes the corresponding UHF glideslope frequency. A brief discussion of the unit follows. Refer to (Figure 7 - 19) for a picture of the radio.

- **Display –** The Apollo SL30 Nav/Comm uses a single line by 32-character 5x7 dot matrix alphanumeric display. A photocell is located in the top left corner of the front panel display. The photocell automatically controls the light intensity of the display LEDs from low brightness at night to high brightness during daylight operation. A transmit (TX) indicator located above the flip/flop button lights when the Comm radio is transmitting.
- **Power On/Off, Volume, Squelch –** The knob on the left side of the SL30 controls power on/off, volume, and squelch test. Rotate the knob clockwise (CW) past the detent to turn the power on. Continuing to rotate the knob to the right increases speaker and headphone amplifier volume level. Rotate the knob to the left to reduce the volume level. Pull the knob out to disable automatic squelch. The SL30 may be configured to have the volume knob control the Nav and intercom volume, as well as the Comm volume.
- **Large/Small Knobs –** The dual concentric knobs on the right side of the SL30 are used to select frequencies, to view the features available within a function, or make changes. Details are provided in the appropriate sections of the *Apollo Model SL30 NavComm User's Guide*.
- **Flip/Flop –** Press the flip/flop button to switch between the active (left-most) and standby (right-most) frequency. Switching between Com frequencies is disabled while transmitting.
- **Comm –** Press COM to select the Comm radio mode. The annunciator will light above the button when the Comm mode is selected. Press COM a second time to monitor the standby frequency. See the Advanced Operation section in the *Apollo Model SL30 NavComm User's Guide* for more about monitoring frequencies.
- **NAV –** Press NAV to select the Nav radio mode. The annunciator above the button will light when the Nav mode is selected. Press NAV a second time to monitor the standby frequency. See the Advanced Operation section in the *Apollo Model SL30 NavComm User's Guide* for more about monitoring frequencies.
- **SYS –** Press SYS to reach the System mode. The annunciator above the button will light when the System mode is selected.
- **OBS –** Press OBS to see the current OBS setting and graphic CDI. Note that the OBS course setting of the MD-200 or HSI is decoded and displayed on the screen of the SL30.

- **T/F –** Press T/F to toggle between the bearing TO or radial FROM the active VOR. The T/F button does not operate for localizer frequencies and operates independent of the OBS and HSI settings.
- **ID –** Press ID to select the Nav audio and toggle between VOICE or IDENT. Pressing ID will cancel the VOR monitor function. Selecting the monitor function will suspend the ID function until the monitor function is disabled.
- **SEL –** Press SEL to choose from a list of channel types or to change values. In Comm or Nav modes, press SEL to choose frequencies from the available lists. Press SEL again if you want to cancel the selection process. The annunciator will light above the button when this function is active.
- **ENT –** Press ENT to save selected values, confirm a prompt, or save the standby frequency.

Basic Operating Procedures for the SL30 Nav/Comm – Use the following steps for operation and use of the radio's basic features. Advanced operations are discussed in the *Apollo Model SL30 NavComm User's Guide.*

- **Power On –** Turn the SL30 on. Ensure the SL30's Power/Volume knob and the system and avionics master switches are in the on position. The SL30 runs through a short initialization routine and briefly displays the last VOR check date. If the radio is turned off and on for less then 15 seconds, it will bypass the initialization process and return to the previous display.
- **Selecting a Comm Frequency** - New frequencies are first selected as a standby frequency and then toggled to the active side with the flip/flop switch. While viewing the standby frequency display, use the large and small knobs on the right side of the radio to select the desired frequency.
  1. Press COM to reach the Comm radio function. The annunciator above the COM button will light.
  2. Turn the Large knob to change the values in one MHz increments. The MHz selection range is between 118 and 136 in one MHz steps.
  3. Turn the Small knob to change the values in 25 kHz increments. The kHz selection range is between 000 and 975 kHz in 25 kHz steps. Note that only two digits are displayed to the right of the decimal point.
  4. Turn the large and small knobs clockwise to increase and counterclockwise to decrease the frequency values. Standby frequency selection is not inhibited while transmitting.
  5. Press the flip/flop button to toggle the standby frequency to the active frequency.
- **Selecting a Nav Frequency –** The selection of Nav frequencies is the same as for the Comm frequencies. The annunciator above the Nav button will light.
  1. Press NAV to reach the Nav radio function.
  2. Turn the Large knob to change the values in one MHz increments. The MHz selection range is between 108 and 117 in one MHz steps.
  3. Turn the Small knob to change the values in 50 kHz increments.
  4. Press the flip/flop button to toggle the standby frequency to the active frequency.

NOTE

It is not possible to simultaneously display both Nav and Comm frequencies.

- **System Mode –** Software versions, setup of the Nav and Comm functions, and information about the last VOR test are viewable from the system mode. See the Advanced Operations section of the *Apollo Model SL30 NavComm User's Guide* for more details.
- **OBS Mode –** Press OBS to see the current OBS setting and graphic CDI. Note that the OBS course setting of the MD-200 or HSI is decoded and displayed on the screen of the SL30.

- **Recalling Frequencies –** In the Comm or Nav modes, press SEL to gain access to the available frequency lists of each mode. Turn the large and small knobs to view the available channels.
  1. Press COM or NAV to go to the desired mode.
  2. Press SEL to go to the frequency database.
  3. Turn the large knob to review the type of frequency.
  4. Turn the small knob to display the available channels in the selected type.
  5. Press ENT to put the displayed channel into the standby position or press flip/flop to put the displayed channel into the active position. Press SEL again to cancel selection.
- **Emergency Channel –** The standard emergency channel (121.50 MHz) is stored in the Comm memory of the SL30.
  1. Press Com if the radio is not in Comm mode. Press SEL and turn the large knob one position counterclockwise to the emergency channel.
  2. The following display will appear 119.10 s124.55 emergency 121.50 (assume the first two frequencies were previously set into Comm).
  3. Press the flip/flop button to make the emergency channel the active channel.
- **Stuck Mike** – The SL30 has a stuck microphone feature, which suspends radio transmission if the push-to-talk transmit button is depressed for more than 35 seconds. A *Stuck Mic* annunciation will be displayed until the push-to-talk button is released. While actual stuck mike occurrences are rare, the 35-second time-out feature is commonly experienced during pilot-to-pilot communications.

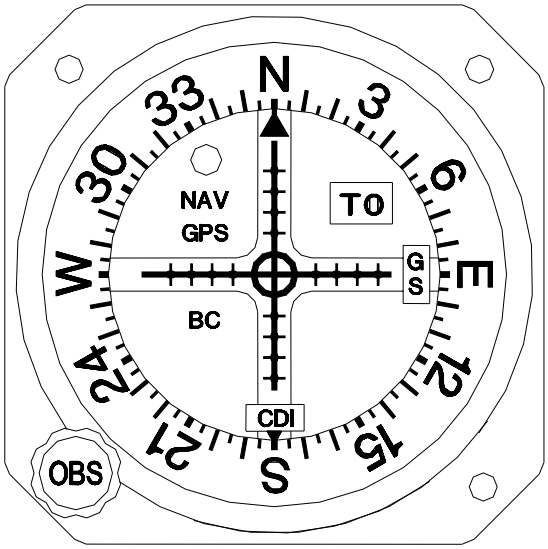
NOTE

If a stuck microphone occurs during an emergency and use of the radio's transmitter is necessary, turn the radio off and then back on using its power switch. This will provide 35 seconds of transmission before the radio times-out.

MD-200 NAVIGATION INDICATOR

Mid Continent Navigation Indicator – The navigation head, frequently referred to as the OBS, is located in the instrument panel next to the vertical speed indicator and just above the throttle. The instrument is selectable for VOR stations, Instrument Landing Systems, and LNAV (lateral navigation) functions. It is important to remember that LNAV cross-track deviation is linear during LNAV operations and angular during VOR operations. There are six basic components in the MD-200 navigation indicator: (1) the Omni Bearing Selector, (2) the azimuth card, (3) the To/From & Flag Indicator, (4) the glideslope flag, (5) the VOR/LOC/NAV deviation bar, and (6) the glideslope deviation bar. A drawing of the instrument appears in (Figure 7 - 20).

DRAWING OF MD-200 NAVIGATION INDICATOR



(Figure 7 - 20)

Radio navigation and approach information from the No. 1 SL30 and GX50 GPS is only displayed on the HSI. The source of the navigation information, i.e., GPS or navigation radio, depends on the selection of ACU. (See page 7-55 for a discussion of the H14ACU.) Radio navigation and approach information from the No. 2 SL30 is only displayed on the MD-200 navigation indicator.

VOR Station – When VOR data is sent to the MD-200 navigation indicator, the instrument provides course information to and from the VOR station. If the OBS is moved so that the needle is centered, the course displayed above the triangular pointer is the course to or from the station depending on the reading of the TO/FROM indicator. For example, if the heading of the airplane is similar to the course indicated by the azimuth card and a To indication is displayed, under no wind conditions the airplane will generally be on a course to the station. If the CDI indication moves to the right or left, then the course selected is to the right or left of the airplane.

Localizer – The localizer is one of the components of the Instrument Landing System and provides information about the airplane's alignment with the approach runway. The localizer frequencies are part of the VHF navigation band and range from 108.10 to 111.95 MHz on the odd kHz settings. While the OBS does not influence localizer indications, it is a good idea to adjust the azimuth card to the same course as the localizer. The localizer is much more sensitive than the VOR, and smaller left and right corrections are required to center the CDI. On a front course approach, a needle deflection left or right means the runway centerline is to the left or right.

Glideslope – The glideslope or glidepath indicator provides information about the airplane's vertical position during the approach to the runway. The glideslope operates in the UHF frequency band and is automatically paired with the selected VHF localizer frequency. The horizontal needle in the navigation head indicates the airplane's position along the glideslope. If the horizontal needle is deflected up, then the airplane is below the prescribed glidepath. A down needle means the airplane is too high. The glideslope must only be used when the warning flag is not displayed in the glideslope window. The glideslope is not usable on the back course. In

addition, pilots must be alert when approaching the glidepath interception. False courses and reverse sensing will occur at angles considerably greater than the published path of about three degrees.

MD-200 Annunciators – When the back course localizer function is selected on the No. 2 SL30, the BC function in the left lower quadrant of the instrument illuminates. No NAV/GPS annunciations are provided since this instrument only provides navigational information, i.e., VOR or ILS.

To review, the No. 1 SL30 and GPS provide data to the HSI, depending on the selection made on the H14 GPS Annunciator Unit. The No. 2 SL30, which is connected to the MD-200, can only provide navigation information to the MD-200. It is not possible to switch the navigator source to a different indicator, i.e., transfer nav data from the No. 2 radio to the HSI.

APOLLO SL70 ATCRBS TRANSPONDER

General – The SL70 Air Traffic Control Radar Beacon System (ATCRBS) transponder is located in the lower portion of radio rack panel assembly. The unit has the capability of transmitting on 4096 discrete codes and is equipped with Mode C altitude reporting capabilities. A photocell on the front of the SL70 adjusts the LED intensity for ambient light conditions. The SL70 will automatically test its receive function if no interrogations have been received in the last 30 seconds. A photocell on the front of the SL70 adjusts the LED intensity for ambient light conditions.

A picture of the SL70 is shown in (on page 7-62. The SL70 is divided into four basic parts which include: (1) the ON/OFF switch, IDENT button, and mode select buttons on lower left side of the unit's panel, (2) the code display portion in the upper left of the panel, (3) the altitude hold and code select knobs on the lower right side of the panel, (4) the altitude display window on the upper right side of the unit.

ON/OFF Knob – A single knob on the left side of the unit turns power on and off. Rotate the knob clockwise to turn transponder power on and counterclockwise to turn power off. When the knob is in the OFF position, the unit is off and nothing will appear in the display window. When the transponder is first turned on it automatically goes to the standby mode and will display the VFR Code.

Ident Button – The Ident (IDT) button should only be depressed when directed to do so by ATC. Pushing the button appends a Special Position Identification (SPI) to the code transmitted and permits rapid detection by ATC. When the Ident button is depressed, the Reply LED will be lighted for 20 seconds. The Reply (Ident) LED will also flash when the SL70 generates transponder replies

Mode Buttons – An LED above each mode pushbutton will light when that button is pressed. When the transponder is in the **SBY** (Standby) position, the unit is energized but will not reply to interrogations. In the **ON** mode, the unit can reply to all Mode A and Mode C interrogations; however, the altitude reporting information available on Mode C is not accessible. No information will be displayed in the altitude window. When the **ALT** (Altitude) mode is selected, the unit can respond to all Mode A and C position interrogations, as well as altitude information for Mode C interrogations. Pressing the **VFR** button once sets in the VFR squawk code. Press the button a second time to toggle between the VFR squawk code and the previously entered code.

Code and Altitude Display Windows – The display window shows the code selected on the left side and altitude information on the right side. Altitude information is displayed hundreds of feet, i.e., 095 indicates a pressure altitude of 9,500 feet. The displayed pressure altitude is generated by the Trans-Cal SSD 120 encoder/digitizer. The indication in the ALT/FL window is usually different from the indication of the airplane's altimeter. The altitudes displayed on the transponder and the altimeter should approximately agree when the airplane's altimeter is set to 29.92 inches Hg. The example in (Figure 7 - 21) shows a pressure altitude of 7,500 feet.

Code Select Knob – The selected squawk code will always be in use. As a squawk code is changed, the original code is sent until the new code is selected. The dual concentric knobs on the right side of the unit are used to select squawk codes. Turning the outer knob moves the cursor to allow editing of the selected character. Turning the inner knob changes values. To select a code, use the following procedure.

1. Rotate the outer knob clockwise one position; the first character of the squawk code will flash.
2. Rotate the inner knob to the desired number for the first digit.
3. Rotate the outer knob to move the cursor to the next desired digit. Turn the small knob to select the desired number.
4. Repeat step 3 for each of the desired digits.
5. After the last digit is selected, rotate the outer knob clockwise one more position. The display will stop flashing. The new code is now selected.

Timing Out – It is important that code inputs are performed in a prompt manner. If the code select knobs are not used for three seconds or more, the display will stop flashing and code selection is terminated. Moreover, pressing any of the mode pushbutton will end code selection.

PICTURE OF THE SL70

(Figure 7 - 21)

Altitude Hold – Altitude Hold helps the pilot maintain a constant altitude. Repeated input to the HLD button enables and disables altitude hold. The LED above the HLD button is lighted when altitude hold is enabled. When the HLD button is pressed, the altitude display will indicate "+000." The altitude display values will increase/decrease as the aircraft changes altitude. The altitude display will flash when the airplane's change in altitude exceeds the selected threshold.

Setting Altitude Hold – Press the HLD button to set the current altitude as the hold altitude. The LED above the HLD button will light, indicating that Altitude Hold is active. The altitude displayed is a value relative to the hold altitude, in 100-foot increments. A displayed value of

+001 means the airplane is 100 ft. above the hold altitude. The altitude display will flash when the airplane's change in altitude exceeds the selected threshold established in the hold buffer.

Setting the Altitude Hold Buffer – Set the Altitude Hold Buffer value by pressing the HLD button for two seconds, or longer. Select a value between 200 and 2500 feet by turning the inner knob to change the buffer value, such as ±002 for 200 feet. Press HLD again to save the value, which is retained when the SL70 is turned off. If the holding buffer value is not changed, the factory default value of 300 feet is displayed when the Altitude Hold mode is made active.

TRANS-CAL SSD 120 BLIND ENCODER/DIGITIZER

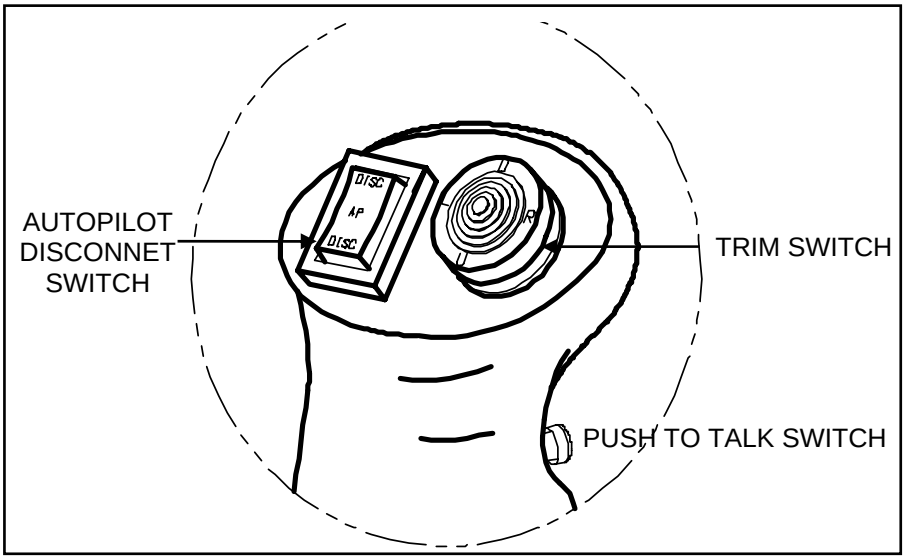
General – The Trans-Cal SSD 120 encoder is a self-contained, solid-state electronic device that determines the pressure altitude of the airplane. The device samples atmospheric pressure from the airplane's static system with the barometric scale of the encoder set to 29.92 inches Hg. The pressure altitude of the airplane is then converted to a digital equivalent or is encoded. When the encoder is connected to the airplane's transponder in Mode C operations and receives an interrogation from an air traffic control entity, the unit will transmit the encoded pressure altitude to the ground station. The ground station corrects the encoded pressure altitude for local pressure variations before the altitude of the airplane is displayed on the ground-based system.

Depressing the altitude (ALT) button on the SL70 transponder will activate the encoder. If the solid-state pressure sensor has had sufficient time to warm up and stabilize, it will reply to Mode C altitude interrogations. It is important to realize that changing settings in the Kollsman window of the airplane's altimeter does not affect the blind encoder. However, an incorrect altimeter setting will cause the airplane to fly at an altitude different from the assigned altitude, and the incorrect or unassigned flight altitude will be displayed on the ground-based radar. When ATC indicates that the altitude readout is invalid, the first thing the pilot should check is the airplane's altimeter setting.

Altitude Range and Accuracy – The encoder is designed to provide reliable altitude information from a pressure altitude of -1,000 feet to a pressure altitude of 30,000 feet. Within this range of operating pressure altitudes, the encoder is accurate to ± 50 feet.

CONTROL STICK SWITCHES & HEADSET PLUG POSITIONS

As discussed on page 7-10, there is a hat switch on the top portion of the pilot's and copilot's control stick for operation of the trim tabs. In addition, both sticks have a Push-to-talk (PTT) microphone transmitter switch and the pilot's stick has an autopilot function switch (AFS). Please see (Figure 7 - 22) for a drawing of the pilot's control stick grip.



(Figure 7 - 22)

Autopilot Disconnect Switch (ADS) – The ADS is a spring-loaded rocker switch on the top left side of the pilot's control stick and is normally operated with the thumb of the left hand. Pressing the bottom or top portion of the rocker switch will disengage the autopilot. The top and bottom of the switch is engraved with the letters DISC. (Note: Operating the elevator trim switch will also disconnect the autopilot; however, the elevator trim switch should not be used in lieu of disconnecting the autopilot with the ADS.) See the applicable supplement in Section 9 for a detailed autopilot discussion.

Push to Talk (PTT) Switch – The PTT is a trigger switch on the forward side of the grip and, on the pilot's side, is engaged with the index fingertip of the left hand. There is a PTT switch on the copilot's stick that is normally operated with the index fingertip of the right hand. The PTT switches are used in conjunction with headsets that have a small, adjustable, boom-type microphone.

Plug Positions – The airplane has four headset plug positions, two in the front seat area on the floor next to the center console and two in the backseat area under each fresh air vent. The headsets, in conjunction with voice activated microphones, are normally used for communications and intercom functions. See page 7-49 for a discussion of the audio panel and intercom. However, either the pilot's or copilot's plug can be used to add a hand-held microphone if desired. The airplane has special Bose headset plugs, which are designed to operate with the special noise canceling headsets. There is a significant reduction in cabin noise when the Bose product is used.

Headsets – It is suggested that the owner or operator purchase headsets for use in the airplane, as opposed to use of a hand-held microphone and cabin speaker. Pilot and passenger comfort is enhanced in terms of noise fatigue, and the use of headsets facilitates both radio and intercom communications. Moreover, in situations involving extended over water operations, where two microphones are required, a second headset with a boom mike will fulfill this requirement and eliminate the purchase of a seldom-used, hand-held microphone.

MISCELLANEOUS ITEMS

EMERGENCY LOCATOR TRANSMITTER (ELT)

General – The Emergency Locator Transmitter (ELT) is installed in the airplane as required by Federal Aviation Regulations to aid in search and rescue operations. It is located aft of the baggage compartment hat rack or storage shelf. There is an access panel in the vertical partition of the storage shelf with the following placard: EMERGENCY LOCATION TRANSMITTER LOCATED AFT OF THIS POINT. IT MUST BE MAINTAINED IN ACCORDANCE WITH FAR PART 91. (U.S. operating rules do not apply in Canada.) In this instance, the ELT battery must be replaced every two years (Artex 200) or every 5 years (Artex ME406). The batteries must also be replaced when the transmitter has been in use for more than one cumulative hour; or when 50 percent of their useful life has expired. The access panel is secured with Velcro strips and is removable.

Artex 200 ELT – The ELT is automatically activated from the ARM setting with a G-force or change in velocity of more than 3.5 feet per second. When activated, the unit will transmit a signal on 121.5 and 243.0 MHz for about 50 hours depending on the age and condition of the battery. The range of the ELT depends on weather and topography. Transmission can be received up to 100 miles distant depending on the altitude of the search aircraft. In case of a forced landing in which the ELT is not activated, the unit can be turned on with either the remote switch or the switch on the ELT. Do not turn the ELT off even at night, as search aircraft may be en route 24 hours per day. Turn off the unit only when the rescue team arrives at the landing site.

Switches – There is a two position remote ELT switch located under the knee bolster on the copilot's side which is used to arm, test, and reset the transmitter. In addition, there is a three-position switch on the ELT that is used to arm, test, reset, and turn off the unit. Under normal conditions, the switch on the ELT is set to the ARM position, and accessing the unit is unnecessary since most functions are accomplished with the remote switch. The one exception is the ELT cannot be turned off with the remote switch. In the event the ELT remains on during normal operations and cannot be reset, moving the three position toggle switch on the ELT to neutral turns off the transmitter.

Since there are three selectable switch positions on the ELT and two positions on the remote panel, a total of six switch combinations exist. The table below (Figure 7 - 23) summarizes the six possible combinations and describes how the unit will work with each switch combination.

ELT Unit Switch Setting	Remote Switch Setting	How ELT Will Function
ARM (Normal)	ARM (Normal)	ELT G-switch is activated by 3.5 ft. /sec. change in velocity
ON	ARM	Overrides G-switch and activates ELT. Normally this setting is used for maintenance and emergencies when the ELT is not activated.
ARM	ON	
ON	ON	
OFF	ARM	WARNING, the ELT will not operate under any of these conditions.
OFF	ON	

(Figure 7 - 23)

Testing and Reset Functions – If the ELT is tested while installed in the airplane, use the following procedures. First, the test shall be conducted only during the first 5 minutes after any hour unless special arrangements are established with the controlling ATC entity. Next, place the remote switch in the ON position and verify that the red light on the remote switch flashes. Also, verify that the ELT is heard on the airplane's communication radio, which shall be set to 121.5 MHz. Limit the test period to about three bursts or three flashes of the remote red light, and then move the remote switch to the ARM position. Verify that a signal is no longer audible on 121.5 MHz and that the red light on the remote switch is not flashing.

If desired, a system function test is possible using the switch combinations in (Figure 7 - 23) with verification that the appropriate function is displayed. Remember that the functional check does not verify the condition of system components such as antenna, G-switch, cabling, and battery condition.

During post flight shutdown operations, monitoring 121.5 MHz on the communications radio will verify the absence of an ELT transmission. If an ELT tone is heard, reset the unit by moving the remote switch to the ON position for one second and then moving the switch back to the ARM position. The ELT, if it is functioning properly, should be reset. If this procedure does not reset the ELT and a tone is still audible on the communication radio, the ELT must be turned off by moving the switch on the transmitter to the neutral position. The problem with the ELT shall be corrected in a timely manner. Refer to FAR 91.207 for additional information. (U.S. operating rules do not apply in Canada.)

Artex ME406 ELT – In the event of a crash, the ME406 activates automatically, and transmits the standard swept tone on 121.5 MHz lasting until battery power is gone. This 121.5 MHz signal is mainly used to pinpoint the beacon during search and rescue operations.

NOTE

In October 2000 the International Cospas-Sarsat Program, announced at its 25th Council Session held in London, UK that it plans to terminate satellite processing of distress signals from 121.5 and 243 MHz emergency beacons on February 1, 2009.

In addition, for the first 24 hours of operation, a 406 MHz signal is transmitting at 50- second intervals. This transmission lasts 440 ms and contains identification data programmed into the beacon and is received by Cospas-Sarsat satellites. The transmitted data is referenced in a database (maintained by the national authority responsible for ELT registration) and used to identify the beacon and owner.

Accuracy – Doppler positioning is employed using both 121.5 MHz and 406 MHz signals. Position accuracy of the 121.5 MHz signal is within an area of approximately 15-20 km radius about the transmitter. Due to the better signal integrity of the 406 MHz, its location accuracy is within about a 3 km radius.

Switch Operation – An acceleration activated crash sensor (G-switch) turns the ELT 'on' automatically when the ELT experiences a change in velocity (or deceleration) of 4.5 fps ±0.5 fps. Activation is also accomplished by means of the remote switch located to the right of the MFD or the panel (local) switch on the ELT. To deactivate the ELT set either switch to the

'ON' position, then back to 'ARM'. The ELT does not have an 'OFF' position. Instead, a jumper between two pins on the front D-sub connector must be in place for the G-switch to activate the unit. The jumper is installed on the mating half of the connector so that when the connector is installed, the beacon is armed. This allows the beacon to be handled or shipped without 'nuisance' activation (front connector removed).

NOTE

The ELT can still be manually activated using the local switch on the front of the ELT.

Care should be taken when transporting or shipping the ELT not to move the switch or allow packing material to become lodged such as to toggle the switch.

Self Test Mode – Upon turn-off, the ELT automatically enters a self-test mode that transmits a 406 MHz test coded pulse that monitors certain system functions before returning to the 'ARM'ed mode. The 406 MHz test pulse is ignored by any satellite that receives the signal, but the ELT uses this output to check output power and correct frequency. If the ELT is left activated for approximately 50 seconds or greater, a distress signal is generated that is accepted by one or more SAR satellites. Therefore, when the self-test mode is required, the ELT must be activated, then, returned to 'ARM' within about 45 seconds otherwise a "live" distress message will be transmitted.

NOTE

All activations of the ELT should be kept to a minimum. Local or national regulations may limit testing of the ELT or special requirements or conditions to perform testing. For the "self test", Artex recommends that the ELT be "ON" for no more than 5 seconds during the first 5 minutes after the hour.

In addition to output power of the 121.5/406 MHz signals and 406 MHz frequency, other parameters of the ELT are checked and a set of error codes generated if a problem is found. The error codes are displayed by a series of pulses of the ELT LED, remote LED and alert buzzer. See below.

Testing – Always perform the tests within the first 5 minutes of the hour. Notify any nearby control tower of your intensions, in accordance with AC 43.13-1B, Section 12-22, Note 3. If outside of the US, always follow all local or national regulations for testing of ELT's.

WARNING

Do not allow test duration to exceed 5 seconds.

Any time the ELT is activated it is transmitting a 121.5 MHz distress signal. If the unit operates for approximately 50 seconds, a "live" 406 MHz distress signal is transmitted and is considered valid by the satellite system. Any time that the ELT is cycled from "ARM" to "ON" and then back to "ARM", a 406 MHz signal is transmitted, however it is specially coded as a "self test" signal that is ignored by the COSPAS-SARSAT satellites.

NOTE

The self-test time is accumulated in a register on the battery pack. The register records activation time in 30 second increments so all activations will count as at least 30 seconds, even if the actual time is much less. Total allowable time is 60 minutes as determined by FAR 91.207 and RTCA DO-204. After this time has been accumulated a 7- flash error will be presented after the self test. The battery must be replaced at this point for the ELT to remain in compliance. Always follow ELT testing requirements per local or national authorities.

Tune a receiver (usually the aircraft radio) to 121.5 MHz. Turn the ELT aircraft panel switch "ON" for about 1 second, then back to the "ARM" position. The receiver should voice about 3 audio sweeps. At turn-off (back to 'ARM' state) the panel LED and buzzer should present 1 pulse. If more are displayed, determine the problem from the list below. Codes displayed with the associated conditions are as follows:

1 Flash – Indicates that the system is operational and that no error conditions were found.

3 Flashes – Bad load detect. Detects open or short condition on the antenna output or cable. These problems can probably be fixed by the installer.

- Check that the RF cable is connected and in good condition. Perform continuity check of center conductor and shield. Check for a shorted cable.
- Check for intermittent connection in the RF cable.
- If this error code persists there may be a problem with the antenna installation. This can be checked with a VSWR meter. Check the antenna for opens, shorts, resistive ground plane connection.

4 Flashes – Low power detected. Occurs if output power is below about 33 dBm (2 watts) for the 406 signal or 17 dBm (50 mW) for the 121.5 MHz output. Also may indicate that 406 signal is off frequency. For this error code the ELT must be sent back for repair or replacement.

5 Flashes – Indicates that the ELT has not been programmed. Does not indicate erroneous or corrupted programmed data.

6 Flashes – Indicates that G-switch loop between pins 5 and 12 at the D-sub connector is not installed. ELT will not activate during a crash.

- Check that the harness D-sub jumper is installed by verifying less than 1 ohm of resistance between pins 5 and 12.

7 Flashes – Indicates that the ELT battery has too much accumulated operation time (> 1hr). Battery may still power ELT; however, it must be replaced to meet FAA specifications. May also indicate damage to the battery circuit.

FIRE EXTINGUISHER

General – The airplane fire extinguisher is located below the copilot's seat in a metal bracket and is mounted parallel to the lateral axis. The extinguisher is stored with the top of the unit near the middle of the airplane so that the it is accessible from the pilot's seat.

The extinguisher is filled with a 1211/1301 Halon mixture (commonly called Halonaire) that chemically interrupts the combustion chain reaction rather than physically smothering the fire. The hand extinguisher is intended for use on Class B (flammable liquids, oil, grease, etc) and Class C (energized electrical equipment) type fires.

Temperature Limitations – The fire extinguisher has temperature storage limitations that may need to be considered depending on the operating environment of the airplane. If it is anticipated that the cabin temperature will exceed the extremes shown in the table below (Figure 7 - 24) the extinguisher must be removed and stored in a more temperate location.

Temperature Extremes	Maximum/Minimum Temperatures
Lowest Cabin Temperature	-40ºF (-40ºC)
Highest Cabin Temperature	120º F (49ºC)

(Figure 7 - 24)

Operation and Use – To operate the fire extinguisher, use the following procedures after securing the ventilation system:

1. Remove the fire extinguisher from its mounting bracket by pulling up on the bracket release clamp.
2. With the unit in an upright position, remove the retaining pin from the handle.
3. Discharge the extinguisher by pushing down on the top handle. For best results, direct the discharge towards the base of the fire, near the edge. Use a small side-to-side sweeping motion while moving towards the back of the fire. The extinguisher has a continuous discharge capability of approximately eight seconds. Do not direct the initial discharge at the burning surface at close range since the high velocity stream may scatter the burning materials.
4. Short bursts from the extinguisher of one or two seconds are more effective than a long continuous application.
5. When the fire is extinguished, open all ventilation and return the fire extinguisher to its mounting bracket. Do not lay it on the floor or in a seat.
6. Have the fire extinguisher replaced or recharged before the next flight.

LIGHTNING PROTECTION/STATIC DISCHARGE

While composite construction provides both strength and low air resistance, it does have high electrical resistance and, hence, very little electrical conductivity. Conductivity is necessary for lightning protection, since it is important that all parts of the airplane to have the same electrical potential. Moreover, in the event of a lightning strike, the energy is distributed to and absorbed

by all the skin area, rather than to an isolated location. One method of lightning protection, which is used in this airplane, is achieved by integrating aluminum and copper mesh as part of the composite sandwich. The depth of the mesh varies from 10 to 30 thousandths of an inch below the surface of the paint and encompasses most surfaces of the airplane. The various parts of the airplane are then interconnected through use of metal fasteners inserted through several plies of mesh, mesh overlaps, and bonding straps.

WARNING

The thickness of the surface paint is important for lightning protection issues, and the color is important because of heat reflection indices. The owner or operator of the airplane must only repaint the airplane according to the specifications for Columbia 300 LC40-550FG as shown in the airplane maintenance manual.

Static wicks are used to bleed an accumulated static electrical charge off the airplane's surface and discharge it into the air. An airplane that does not properly dissipate static build-ups is susceptible to poor or inoperative radio navigation and communication. The wick is made of carbon, enclosed in a plastic tube. One end of the wick is connected to the trailing edge of a airplane's surface, and the other end sticks out into the air. As the airplane flies through the air, static electricity builds up on the surfaces, travels through the mesh to the static wicks, and discharges into the air. The over application of wax increases the generation of static electricity. See page 8-17 in Section 8 for instructions about the care of the airplane's surfaces. Also refer to page 4-15 in Section 4 for more information about the static wicks.

OPTIONAL EQUIPMENT

FLIGHTMONITOR (FMP300 SERIES)

Overview – The FlightMonitor is classified as a FSD or Flight Situation Display. The 10.3 inch display is similar to a laptop computer screen and uses a popular commercial operating system. The FlightMonitor is located to the right of the flight instrument panel, while the input controls for the FlightMonitor's computer are just below the center armrest. The controls are intuitive and easy to operate using one hand. The knobs and buttons are well separated and visual access is not necessary. The FlightMonitor is a joint venture of the Avidyne and AvroTec Corporations; however, AvroTec provides hardware and software support, and all warranty and/or technical inquiries should be to them.

The unit interfaces with the GPS and displays the airplane's position on an assortment of aeronautical charts, i.e., WAC, Sectional, Area, Low Altitude, and High Altitude charts. In addition, the unit has a Navigator module that is useful for flight planning and getting a general overview of a proposed route. Lightning data from the BF Goodrich WX 500 Stormscope™ can also be displayed and analyzed. The software contains a database, which provides airport information similar to most commercial GPS's.

User's Manual – The FlightMonitor can be used for VFR and IFR operations to enhance situational awareness, however, current charts appropriate for the intended operations must be carried onboard the airplane. An *AvroTec FlightMonitorFMP300 Series User's Manual* is included as part of the *Pilot's Operating Handbook* and *The FAA Approved Flight Manual* and is the primary source document for operation of the unit. Proper use of the many features requires some practice and study. However, the long-term benefits more than justify the time devoted to learning the system. It is recommended that the guide be reviewed at some length and an hour or so of practice under VFR conditions occur before using the FlightMonitor for complex operations.

Subscription – The charts and the Navigator information is updated using a CD and CD player. A CD player is included with the FlightMonitor. The parallel port cable for chart updates is located behind the center console access panel on the co-pilot's side. For more details about subscriptions, pricing, etc., contact AvroTec, Inc. at the phone number provided in *AvroTec FlightMonitorFMP300 Series User's Manual*

BF GOODRICH WX-500 AND WX-950 STORMSCOPE®

The model number installed depends on whether an AvroTec FlightMonitor is installed. The WX500 is used for airplanes with a FlightMonitor and the WX-950 is provided on airplanes that do not have a FlightMonitor. The only difference between the two systems is the display. The WX-950 is displayed on a dedicated panel-mounted instrument, and the WX-500 is displayed on the FlightMonitor.

WX-500 Users Guide – If the WX-500 is installed, the *AvroTec FlightMonitorFMP300 Series User's Manual* and the *WX-500 Stormscope® Series II Weather Mapping Sensor User' Guide* are included as part of the *Pilot's Operating Handbook* and *The FAA Approved Flight Manual* and are the primary source document for operation of the unit.

WX-950 Pilot's Guide – If the WX-950 is installed, the *Pilot's Guide for the Stormscope® Series II Weather Mapping Systems Model WX-950* is included as part of the *Pilot's Operating*

Handbook and *The FAA Approved Flight Manual* and is the primary source document for operation of the unit.

Brief Operational Overview – The antenna detects the electric and magnetic fields generated by intra-cloud, inter-cloud, and cloud to ground electrical discharges and sends the resulting signals to the processor. The processor digitizes, analyzes, and converts the signals into range and bearing. A clustering algorithm is then used to identify the location of storm cells within a 200 nautical mile radius of the airplane. This information is then sent to the FlightMonitor or the installed Stormscope® display unit, which plots the location of the associated thunderstorms. The WX-500/950 is a passive sensor that listens for electromagnetic signals with a receiving antenna and operates as well on the ground as it does in the air.

It should be noted that there are general limitation to use of lightning detectors. They are not tactical devices that can be used for circumnavigating specific storm cells. Rather, they provide a generalized location and range of areas with potentially dangerous weather. When using the WX-950, information is projected onto the 3-inch display/processor in the instrument panel if the system is on and the unit is the display mode. When using the WX-500, data is continuously sent when the FlightMonitor is on. If the FlightMonitor lightning detector display is not active, a "Lightning Ahead" message will be annunciated at the bottom of the FlightMonitor.

J.P. INSTRUMENTS EDM-701 DIGITAL ENGINE SCANNER

A JPI Pilot's Guide is included as part of the *Pilot's Operating Handbook* and *The FAA Approved Flight Manual* and is the primary source document for operation of the unit. The discussion below is intended to provide the pilot with a brief overview of the unit's operation.

The EDM-701 is installed in the engine instrument panel in the lower right position and displays CHT and EGT in digital and analog format. The analog display is a vertical bar graph of EGT temperatures for each cylinder presented as a percentage of 1650ºF. A dot over the vertical bar indicates which cylinder's temperature is currently being displayed. Below the bar graph, the EGT and CHT temperatures are displayed next to each other. Missing bars at the base of the vertical columns indicate the hottest and coldest CHT trend.

The Lean Find mode is used to determine the leanest cylinder. To use this function, press the LF button. During constant power cruise, pressing the LF button for five seconds will cause the vertical bar graph to level at mid scale representing the peaks of each column. At this point, each bar represents 10°F and acts as an EGT trend monitor. Press the LF button again to return to normal function.

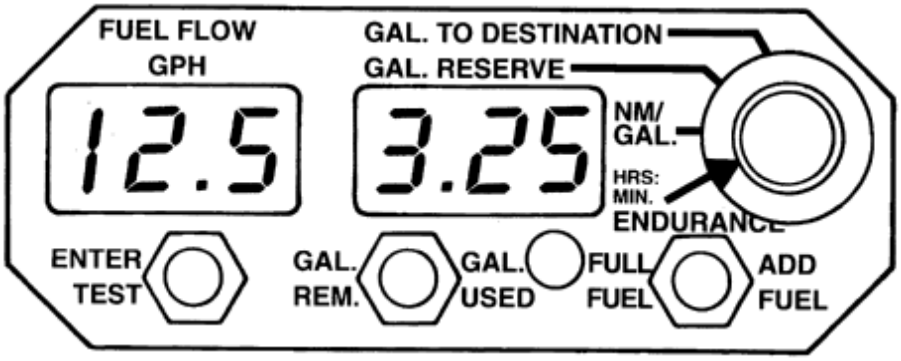
The CHT limit of 460°F is programmed at the factory, however, it may be re-programmed to set a lower CHT limit as a pre-warning.

1. Press the reset button located in the small hole in the back of the instrument marked RS when the power is on.
2. Press the STEP button to index to the "CHT HI" alarm.
3. Hold in the LF button to increase the limit and tap it to decrease the limit.
4. Continue pressing the STEP button to index past the "END Y" choice.

SHADIN MINIFLO-L™ DIGITAL FUEL MANAGEMENT SYSTEM

A Shadin Miniflo-L Pilot's Guide is included as part of the *Pilot's Operating Handbook* and *The FAA Approved Flight Manual* and is the primary source document for operation of the unit. The discussion below is intended to provide the pilot with a brief overview of the unit's operation.

The Miniflo-L is installed in the flight instrument panel above the attitude indicator. This instrument provides fuel flow management during flight without entering information other than the initial fuel on board. The system consists of the fuel flow transducer, the GPS receiver, and the panel-mounted unit. The system provides various information to the pilot for fuel management as described in the paragraph 1. The system is initially programmed at the factory with the useable fuel and then is programmed by the pilot prior to each flight as described in paragraph 5. Please see (Figure 7-24) for a drawing of the Shadin Miniflo-L.



(Figure 7 - 25)

1. **Functions** – The following fuel flow management functions are provided:
   - **Range**—the distance the aircraft may travel in nautical miles.
   - **Fuel to Destination**—the fuel needed to reach a destination or waypoint based on the actual wind conditions, assuming ground speed, track, and fuel flow remain constant. To display Fuel to Destination in the right display window, rotate the rotary switch to FUEL TO DEST. Readings during climb and descent are invalid.
   - **Fuel Reserve**—the amount of fuel on board when the aircraft reaches its destination assuming ground speed, fuel flow, track, and altitude remain constant. To display Fuel Reserve in the right display window, rotate the rotary switch to F. AT DEST. Readings during climb and descent are invalid.
   - **Endurance**—the time left to fly, displayed in hours and minutes, based on amount of fuel remaining and current fuel flow. To display Endurance in the right display window, rotate the rotary switch to ENDURANCE. The display window will flash in this mode if the time remaining to fly at the present power setting is less than 45 minutes.
   - **Fuel Used**—the amount of fuel used since the last fuel entry or reset. To display Fuel Used in the right display window, move the USED/REM toggle switch to the USED position. The Fuel Used will continue to be displayed as long as the switch is held in the USED position and for three seconds after the switch is released.
   - **Fuel Remaining**—the amount of fuel on board. To display Fuel Remaining in the right display window, move the USED/REM toggle switch to the REM position. The Fuel Remaining will continue to be displayed as long as the switch is held in the REM position and for three seconds after the switch is released.

- **Not Enough Fuel**—the display and a negative sign followed by the amount of fuel short to reach the destination will flash when the fuel needed to reach the destination is more than the fuel remaining on board. For the flashing display, the rotary switch must be in the FUEL TO DEST. position.
- **Fuel Reserve Will Be Used**—the display will flash if the endurance is less than the time to reach the destination plus 45 minutes at the current cruise power setting. For the flashing display, the rotary switch must be in either the FUEL TO DEST. or the F. AT DEST. position.
- **Fuel Flow**—the fuel flow per hour to a tenth of a gallon up to 100 gallons and to the nearest gallon above 100 gallons. When displayed in pounds, the display is to the nearest pound up to 999 lb/hr and to the nearest 10 lb. above 999 lb/hr. Fuel flow is displayed continuously on the left display window.
- **Nautical Miles Per Gallon**—to display Nautical Miles Per Gallon in the right display window, rotate the rotary switch to NM GAL.

2. **Initial Programming** – Initial programming is done at the factory and is used to enter the total usable fuel into the memory. The unit should only be reprogrammed if a modification to the aircraft that changes the fuel tank capacity is completed and the reprogramming is done in accordance with the maintenance manual.
3. **Diagnostic Testing** – The system contains diagnostic software that may be used to test the system. To activate the function, press the ENTER/TEST button. If the test is successful, "GOOd" will appear in the display window for three seconds. If the test is not successful, "bAd" and an error message will be displayed. If "bAd" is displayed, the system is not working properly and can not be used until serviced in accordance with the maintenance manual.

NOTE

Using the test function while the engine is running will cause the computer to lose 17 seconds of fuel count.

4. **Preflight Check Programming –** Prior to flight, complete the diagnostic test by following the instructions in paragraph 3. After the diagnostic test, move the USED/REM toggle switch to the USED position to display the fuel used since the last fuel entry or reset. Next, move the USED/REM toggle switch to REM to display the fuel remaining on board. Finally, verify the remaining fuel on board with the actual fuel on board by checking the fuel tanks.

WARNING

Miniflo-L is a fuel flow measuring system and NOT a fuel quantity sensing device. A visual determination of the usable fuel in the fuel tanks is required and the actual amount of fuel on board should be entered into the system.

5. **Programming –** Before each flight, the Miniflo-L system should be verified or set depending on refueling conditions.
   A. No Fuel Added – If no fuel has been added, the necessary data is stored and no action to set the system is required.
   B. Fuel Tanks Full – If the fuel tanks have been filled the Ramping Method or ADD/FULL Toggle Switch Method may be used.

Ramping Method

1. Move the USED/REM toggle switch to the REM position and hold.
2. Press the ENTER/TEST button to increment the fuel remaining until the total usable fuel is reached.
3. Release the USED/REM toggle switch and the ENTER/TEST button to enter the total usable fuel on board into memory.
4. If the required figure is exceeded follow the instructions for Correcting Fuel on Board Entry Error.

ADD/FULL Toggle Switch Method

1. Move the ADD/FULL toggle switch to the FULL position and hold.
2. Press the ENTER/TEST button.
3. Release the ADD/FULL toggle switch.
4. Moving the USED/REM toggle switch to REM verifies the correct amount of fuel is indicated. The current total usable fuel should be displayed.

C. Partial Fuel Added – If the fuel tanks have been partially filled the Ramping Method or ADD/FULL Toggle Switch Method may be used.

Ramping Method

1. Add the amount of fuel from the refueling meter to the amount of fuel remaining.
2. Move the USED/REM toggle switch to REM and hold.
3. Press and hold the ENTER/TEST button to increment the fuel remaining until the correct figure is reached, then release the button.
4. Release the USED/REM toggle switch. The displayed figure is entered into memory as the fuel remaining on board.
5. If the required figure is exceeded follow the instructions for Correcting Fuel on Board Entry Error.

ADD/FULL Toggle Switch Method

1. Move the ADD/FULL toggle switch to the ADD position and hold.
2. Move the USED/REM toggle switch to REM to increment the fuel amount added until the amount of fuel added is reached.
3. Press the ENTER/TEST button.
4. Release the ADD/FULL toggle switch. The computer will add the added fuel to the fuel remaining and use the total as the current fuel remaining.
5. Moving the USED/REM toggle switch to REM verifies the correct amount of fuel is indicated. The current usable fuel remaining will be displayed.

D. Correcting Fuel on Board Entry Error – If an error was made in entering the fuel amount, the following method may be used.

1. Move the USED/REM toggle switch to USED and simultaneously press and hold the ENTER/TEST button. This action will reset the fuel used and the fuel remaining figure will appear and pause in the display window for four seconds.
2. Continue holding the ENTER/TEST button while the figure decrements.
3. When the correct figure is reached, release both the USED/REM toggle switch and the ENTER/TEST button.

6. **Emergency Procedures –** In case of an electrical power failure in-flight, the fuel flow system will cease to function. After system power is restored, the system will resume accurate fuel flow reading, but time remaining, fuel used, fuel remaining, reserve, gallons to destination, and all other functions and warnings will not be accurate.

APOLLO MX20 MULTI-FUNCTION DISPLAY

The MX20 is an option available on aircraft S/N 40017 and on. An Apollo MX20 Pilot's Guide is included as part of the *Pilot's Operating Handbook* and *The FAA Approved Flight Manual* and is the primary source document for operation of the unit. The discussion below is intended to provide the pilot with a brief overview of the unit's operation.

Two MX20 units are installed on the instrument panel on the copilot's side. The MX20 unit is shown in Figure 7-25. The only controls for the MX20 are on the unit itself. Each unit can display information independent of the second unit.

(Figure 7 - 26)

The unit interfaces with the GX50 GPS and displays the airplane's position on an assortment of aeronautical charts, i.e., WAC, Sectional, Area, Low Altitude, and High Altitude charts. Lightning data from the BF Goodrich WX 500 Stormscope™ can also be displayed and analyzed. The software contains a database, which provides airport information similar to most commercial GPS's.

In order to properly use the MX20, it is important to understand how the MX20 interfaces with the GPS. The GX50 GPS must be operating and be programmed for the MX20 in order for the MX20 to be fully functional. The navigation route desired for display on the MX20 needs to be programmed and activated in the GX50. All navigation route changes need to be made through the GX50. The aircraft altitude encoder provides altitude information to the MX20. The altimeter's barometric correction settings need to be set individually in each MX20 as well as in the GX50.

The selectable orientations for the Custom MAP mode, the IFR Chart Mode, and the VFR Chart Mode are Track-up, Desired Track-up, or North-up orientation while the Terrain Mode only allows for Track-up orientation. Changing modes will go to the last selected orientation of the newly selected mode (i.e., from Terrain to MAP, orientation will automatically go from Track-up to North-up if North-up was the last orientation selected when previously in the MAP mode). The pilot should be alert for automatic changes in orientation when changing modes and ensure that the desired orientation is selected.

The MX20 is Limited to VFR Navigation Only. The information currently displayed on the MX20 is approved only to enhance situational awareness and aid in VFR navigation. It is not certified for use as an IFR instrument. All IFR navigation and IFR operations will be conducted by primary reference to the primary flight instruments, primary navigation systems and displays, and current and approved IFR charts. The MX20 can be operating and can be referenced during IFR conditions to facilitate situational awareness, but it should not be used as an IFR navigation tool. This limitation is not intended to restrict the pilot from using the MX20 as necessary in dealing with an unsafe situation. The pilot should always use the best information available to make timely safety-of-flight decisions. The MX20 Datalink capabilities (Weather Datalink, Flight Information Service, and Traffic) are not currently available with this certification

User's Manual – The MX20 can be used for VFR operations to enhance situational awareness, however, current charts appropriate for the intended operations must be carried onboard the airplane. An *Apollo MX20 User's Guide* is included as part of the *Pilot's Operating Handbook* and *The FAA Approved Flight Manual* and is the primary source document for operation of the unit. Proper use of the many features requires some practice and study. However, the long-term benefits more than justify the time devoted to learning the system. It is recommended that the guide be reviewed at some length and an hour or so of practice under VFR conditions occur before using the MX20 for complex operations.

Subscription – The charts and the Navigator information is updated using a data card. For more details about subscriptions, pricing, etc., contact UPS Aviation Technologies at one of the following phone numbers:

800-252-6726 ext. 3995 (US)
800-654-3415 ext. 3995 (Canada)
503-391-3411 ext. 3995 (International)

GROUND POWER PLUG

The ground power plug is an option available on aircraft S/N 40050 and on. The ground power plug is located behind the left wing between the trailing edge of the flap and the step. The plug allows connection to a 12 volt DC power source for maintenance and allows the engine to be started from a ground power cart. The aircraft power must be off when the plug is connected or disconnected to the 12 volt DC power source. Once connected, the battery can be charged by turning the BATT switch on.

CAUTION

The battery should be carefully monitored while charging. Do not exceed 14 volts DC input.

CAUTION

The master switch should not be turned on until after the engine has started and the ground power plug has been removed.

During normal operation of the ground power plug the BATT and ALT switches should be off to keep from overheating the battery. The procedure for starting the engine using the ground power plug and a power cart is contained on pages 4-7 and 4-7 of this manual.

S-TEC 429 GLOBAL POSITIONING SYSTEM STEERING (GPSS) CONVERTER

The 429 GPSS converter is an option available on aircraft S/N 40036 and on. An S-Tec GPSS Pilot's Operating Handbook is included as part of the *Pilot's Operating Handbook* and *The FAA Approved Flight Manual* and is the primary source document for operation of the unit. The discussion below is intended to provide the pilot with a brief overview of the unit's operation and is taken from the S-TEC manual.

The 429 GPSS converter is an accessory to the S-TEC 55 autopilot system that enables a pilot to switch between heading and GPS navigational signals. During normal flight operations, the GPSS converter can be switched between the heading and the GPSS modes of operation. In the heading mode, the converter receives a heading error signal from the heading bug on the HSI. The converter processes this information and sends the heading error to the autopilot.

When in the GPSS mode, the converter receives ground speed and bank angle digital signals that are calculated and converted to a commanded turn rate. The turn rate is then scaled and converted to a DC heading error signal that is compatible with the S-TEC 55 autopilot. The end result is an autopilot that can be directly coupled to the roll steering commands produced by the GPS, eliminating the need for the pilot to make any further adjustment to the HSI course arrow.

A push button is located next to the clock on the instrument panel and enables the pilot to switch between the HDG and GPSS mode. If the unit is in the HDG mode, autopilot HDG operation will be normal. During flight, if the pilot selects the GPSS mode and valid data is present, the autopilot will begin to track to the GPS waypoint. If the unit is in the GPSS mode and valid data is lost, or if GPSS is selected and valid data is not available, the GPSS indicator located next to the clock will flash to indicate a problem. The aircraft will immediately go wings level until the pilot can program a valid GPS flight plan or switch the unit to the HDG mode.

Preflight Procedures –

1. Turn aircraft master and avionics switches on. The HDG lamp on the GPSS panel switch will illuminate indicating the autopilot, when turned on, will operate normally in heading mode.
2. Turn on the autopilot master switch.
3. Select the HDG mode on the autopilot after the RDY annunciator appears.
4. Move the HSI heading bug left and right. The control wheel should smoothly follow the HDG bug movement.
5. Activate a valid GPS waypoint or flight plan on the GPS Navigator.
6. Press and release the GPSS switch, the HDG lamp should go out and the GPSS lamp should flash. The HDG bug will no longer move the control wheel.
7. Disconnect the autopilot.

NOTE

The GPSS steering function cannot be ground tested even though a valid GPS steering signal is present on the GPS navigator due to the missing ground speed component.

En route Navigation Procedures –

1. Select the HDG mode on the autopilot.
2. Select the HDG mode on the panel-mounted GPSS converter switch.
3. Program and activate the desired destination waypoint or flight plan into the GPS navigator.
4. Select the GPSS mode on the panel mounted GPSS converter switch. Observe that GPSS annunciates steadily.
5. Verify that the autopilot immediately begins tracking to the desired waypoint.

Navigation Procedure Critical Information – The following information is critical to be aware of while using the GPSS.

Anytime the GPS has a valid waypoint programmed into it and the pilot selects the GPSS mode with the autopilot in the HDG mode, the autopilot will immediately begin tracking to the waypoint.

Do not attempt to conduct pilot selectable intercepts (dual mode) when using the GPSS converter since this capability does not exist. Conduct all GPSS operations with the autopilot in the HDG mode only. Selecting any lateral mode besides HDG (NAV, APR, REV, etc.) will decouple the autopilot from the GPSS function.

If the GPSS lamp flashes when engaged, it indicates:

1. The GPS is not on or does not have an active waypoint or flight plan.
2. The bank angle and ground speed signals are not being received or may not be valid.

When operating in the GPSS mode, the autopilot does not use inputs from the HDG bug or course arrow, therefore, the pilot is not required to set these in any specific position. However, the pilot will be required to revert back to the HDG mode to maneuver the aircraft for a holding pattern or procedure turn.

If the GPSS lamp begins to flash, the aircraft will go wings level with 0.5 to 2 seconds. At this time the pilot can either enter a valid GPS waypoint or press and release the GPSS switch to return the autopilot to the HDG mode.

GPS Approach Procedures –

1. Select the HDG mode on the autopilot.
2. Select the HDG mode on the panel mounted GPSS converter switch.
3. Select and activate the desired approach on the GPS navigator.
4. Select the GPSS mode on the panel mounted GPSS converter switch. Observe that the GPSS annunciates steadily.
5. Verify that the autopilot immediately begins tracking to the desired initial approach fix.
6. If the selected approach contains a procedure turn or a holding pattern, the pilot must conduct the following procedures.
7. When approaching the procedure turn, deselect the GPSS mode by pressing the panel mounted switch, thus leaving the autopilot in HDG mode.
8. Lead the aircraft around the procedure turn or holding pattern using the HDG bug on the HSI.
9. When approaching the desired inbound course, once again select the GPSS mode.
10. Conduct the remainder of the approach in the GPSS mode.
11. Monitor course-tracking quality during GPSS operations.

Emergency Procedures – In the event of a malfunction of the GPSS converter or any time it is not performing as expected, do not attempt to identify the system problem. Immediately regain control of the aircraft by disabling and disconnecting the autopilot as necessary. Do not attempt to use the GPSS function until the problem has been identified and corrected.

A GPSS unit malfunction will most likely affect the autopilots heading mode, rendering it unusable. However, it may be possible to use the other autopilot lateral modes such as navigation (NAV) or approach and pitch modes. Exercise caution when examining the use of these functions after a GPSS malfunction.

Section 8
Handling, Servicing, & Maintenance

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INTRODUCTION

This section contains procedures for ground handling of the Columbia 300 (LC40-550FG), as well as recommendations and techniques for routine care of the airplane's interior and exterior. In addition, maintenance intervals and procedures are addressed. Finally, publications, the Lancair Advisory Service, and servicing information are discussed.

GENERAL

The owner or operator of the airplane is responsible for ensuring the airworthiness of the airplane is maintained. The responsibility extends to maintaining the airplane logbooks, ensuring the required inspections are performed in a timely manner, and ensuring that mandatory service directives and part replacements are accomplished within the specified period.

While the owner or operator is responsible for the continued airworthiness of the airplane, the use of an authorized dealer or certified service station will facilitate compliance. It is recommended that the owner or operator of the airplane contact a dealer or a certified service station for service information. All correspondence regarding the airplane should include the airplane serial number.

Fuselage Identification Plate – The airplane serial number, make, model, Type Certificate (TC) number, year of manufacture, and Production Certification (PC) number is contained on the Fuselage Identification Plate on the tail cone of the airplane. The serial number is also listed on the cover page of the *FAA Approved Flight Manual.*

Publications – Owners and noncommercial operators may do preventative maintenance as described in part 43 of the Federal Aviation Regulations. (U.S. operating rules do not apply in Canada.) To do this requires the use of an authorized maintenance manual and possibly, a parts catalog. In some instances, the owner or operator may wish to maintain a copy of the maintenance manual and parts catalog to assist other appropriately certified individuals in maintaining the airplane's continued airworthiness. In either event, a maintenance manual, parts catalog, and other related documentation can be obtained by contacting:

The Columbia Aircraft Manufacturing Corporation
22550 Nelson Road
Bend Municipal Airport
Bend, Oregon 97701-9710
Phone: (541) 318-1144
Fax: (541) 318-1177
Email: Product.Support@FlyColumbia.com

SERVICES AND SERVICING

LANCAIR ADVISORY SERVICE

Changes that affect the Columbia 300 (LC40-550FG), including the maintenance and operation of the airplane, are provided to all registered owners free of charge. The Lancair Advisory will contain two basic types of data, compulsory and informational. Compulsory items must be accomplished within a specified time to maintain the continued airworthiness of the airplane. Informational items are non-binding and usually contain details and tips that enhance the use of the airplane.

Domestic owners will receive information at the address listed in the FAA database. It is important for international airplane owners to advise us of any address changes to ensure uninterrupted advisory information. Individuals who are not registered owners can obtain the advisory service on a subscription basis by contacting the manufacturer at the address listed on page 8-3.

DELIVERY PACKAGE

The items listed below are provided with the airplane when it is delivered to the owner. If any of the items are lost or damaged, replacements can be purchased by contacting the manufacturer at the address shown on page 8-3. Publications are also available for purchase by non-owners.

• Pilot's Operating Handbook and FAA Approved Flight Manual (1)	• Lancair Dealer Directory (1)
• Lancair Warranty Program (1)	• Checklist Booklet (1 Set)
• Columbia 300 (LC40-550FG) Passenger Briefing Card (3)	• ADLOG MRS

FUEL SERVICING

Recommended Fuel Grades

100LL Grade Aviation Fuel (Blue)
100 Grade Aviation Fuel (Green)

Fuel Capacities

Total Capacity: 106 US Gallons (401 L)
Total Capacity Each tank: US 53 Gallons (201 L)
Total Usable Fuel: 49 US Gallons (185 L) in each tank (98 US Gallons (371 L) Total)

Approved Fuel Additives – Under certain ambient conditions of temperature and humidity, water can be supported in the fuel in sufficient quantities to create restrictive ice formation along various segments of the fuel system. To alleviate the possibility of this occurring, it is permissible to add Isopropyl Alcohol to the fuel supply in quantities not to exceed 3% of the total. In addition, ethylene glycol monomethyl ether (EGME) and diethylene glycol monomethyl ether (DiEGME) compounds to military specification MIL-I-27686E may be added for this purpose. The ethylene glycol monomethyl ether and diethylene glycol monomethyl ether compounds must be carefully mixed with fuel concentrations not to exceed 0.15 percent by volume.

It is important that the approved fuel additives are mixed in correct proportions. Consideration is required to ensure the appropriate concentration levels are achieved when the tank is filled. For example, adding 40 gallons (151 L) of fuel with a 0.15 percent concentration of EGME to a tank with 10 gallons (38 L) of untreated fuel will produce a mixture of something less than 0.15

percent. Consideration must also be made for the unusable fuel in the tank since it will be combined with the total mixture.

The additives shall be added as the fuel is introduced to the fuel tank so that the mixture is properly combined. Alternatively, the additive can be mixed with a small amount of fuel in a separate container, such as a five-gallon can, and added to the fuel tank before normal fueling. The table in (Figure 8-1) lists the number of ounces of each additive for a given fuel quantity.

FUEL ADDITIVE MIXTURE TABLE

Fuel Gal. (L)	Isopropyl Alcohol (3%) Fluid Ounces	EGME & Di-EGME (0.15%) Fluid Ounces	Fuel Gal. (L)	Isopropyl Alcohol (3%) Fluid Ounces	EGME & Di-EGME (0.15%) Fluid Ounces
1 (3.8)	3.8	0.2	27 (102.2)	103.7	5.2
2 (7.6)	7.7	0.4	28 (106.0)	107.5	5.4
3 (11.4)	11.5	0.6	29 (109.8)	111.4	5.6
4 (15.1)	15.4	0.8	30 (113.6)	115.2	5.8
5 (18.9)	19.2	1.0	31 (117.3)	119.0	6.0
6 (22.7)	23.0	1.2	32 (121.1)	122.9	6.1
7 (26.5)	26.9	1.3	33 (124.9)	126.7	6.3
8 (30.3)	30.7	1.5	34 (128.7)	130.6	6.5
9 (34.1)	34.6	1.7	35 (132.5)	134.4	6.7
10 (37.9)	38.4	1.9	36 (136.3)	138.2	6.9
11 (41.6)	42.2	2.1	37 (140.1)	142.1	7.1
12 (45.4)	46.1	2.3	38 (143.8)	145.9	7.3
13 (49.2)	49.9	2.5	39 (147.6)	149.8	7.5
14 (53.0)	53.8	2.7	40 (151.4)	153.6	7.7
15 (56.8)	57.6	2.9	41 (155.2)	157.4	7.9
16 (60.6)	61.4	3.1	42 (159.0)	161.3	8.1
17 (64.4)	65.3	3.3	43 (162.8)	165.1	8.3
18 (68.1)	69.1	3.5	44 (166.5)	169.0	8.4
19 (71.9)	73.0	3.6	45 (170.3)	172.8	8.6
20 (75.7)	76.8	3.8	46 (174.1)	176.6	8.8
21 (79.5)	80.6	4.0	47 (177.9)	180.5	9.0
22 (83.3)	84.5	4.2	48 (181.7)	184.3	9.2
23 (87.1)	88.3	4.4	49 (185.5)	188.2	9.4
24 (90.8)	92.2	4.6	50 (189.3)	192.0	9.6
25 (94.6)	96.0	4.8	51 (193.0)	195.8	9.8
26 (98.4)	99.8	5.0	52 (196.8)	199.7	10.0

(Figure 8-1)

WARNING

Mixing of ethylene glycol monomethyl ether and diethylene glycol monomethyl ether compounds is extremely important because concentrations more than the 0.15 percent by volume can have a harmful effect on engine components.

Grounding During Refueling and Defueling – The high-speed characteristics of the airplane make generation of static electricity more likely, so it is important for the airplane to be grounded to the fuel source during refueling and defueling operations. Place the fuel source grounding clamp on the right or left exhaust stack of the airplane before touching the filler neck of the fuel tanks with metal parts of the ground refueling equipment. Remember that refueling is often done at the conclusion of a flight and the exhaust stacks may still be hot, so care must be used when attaching the clamp.

Some defueling is possible using the defueling feature on the delivery system of the Avgas fuel supplier. This procedure is usually adequate for removing fuel when gross takeoff weight is an issue. To completely defuel the airplane, refer to Chapter 12 in the Airplane Maintenance manual.

Fuel Contamination – To test for fuel contamination, fuel samples must be taken from each of the wing drains and from the gascolator before each flight and after the airplane is refueled. There are three types of contaminants that can inadvertently be introduced to the fuel system: (1) sediment such as dirt and bacteria, (2) water, and (3) the improper grade of fuel.

1. The accumulation of sediments is an inherent issue with most aircraft and can never be completely eliminated. Refueling the airplane at the conclusion of each flight and using fuel from a supplier who routinely maintains the filtration of the refueling equipment will lessen the problem somewhat. If specks are observed in the fuel sampler, continue the sampling operation until no debris is observed. Be sure the sampling device is clean before using it.
2. The two more common sources of water contamination are condensation of water from the air within a partially filled fuel tank and water-contaminated Avgas from a fuel supplier. Again, refueling after each flight and proper filtration of the fuel delivery system will mitigate water contamination. Water, which is heavier than Avgas, will collect near the bottom of the sampling device. If water is observed in the fuel sampler, take additional fuel samples until all the water is removed.
3. Aviation fuel is dyed according to its grade and on new aircraft, like the Columbia 300 (LC40-550FG), the filler neck is sized to only accept fuel of the proper grade. Still, the color of the fuel shall be verified according to the specifications on page 8-4, since the fuel truck might have been refilled improperly. If fuels of two different grades are mixed, the fuel sample will be clear. If an inferior, improper grade of fuel is noted, completely defuel both tanks, and refuel with the proper grade of Avgas.

Persistent fuel contamination is a serious problem. If repeated fuel sampling is ineffective or there is chronic contamination, approved personnel must inspect the airplane, and it is unsafe to fly. Two final thoughts about refueling and contamination: First, remember that fuel service personnel are people of unknown training and background. It is always a good idea to personally observe refueling operations. Second, if it is necessary to operate in areas where there is questionable fuel delivery, the use of a portable fuel filter is recommended.

NOTE

There are a number of fuel additives on the market that are formulated for automotive use. While the additives may be beneficial for cars, trucks, etc., they are not approved for aircraft use.

OIL SERVICING

The oil grades shown below are recommended after the initial engine break-in period. Refer to the Required Special Inspections heading on page 8-9 for additional details about oil grades during the engine break-in period. Only lubricant oils conforming to Teledyne Continental Motors Specification MHS-24D (latest revision) can be used. Note, the use of MHS-25 synthetic oils has been removed.

NOTE

Oil is added to the engine through the filler neck that contains the dipstick. To remove the dipstick, rotate it counterclockwise to unseat it; raise the dipstick approximately six to eight inches or until a slight resistance is felt; rotate the dipstick 90º clockwise and remove from the filler neck.

Oil Grades Recommended for Various Average Air Temperature Ranges

Below 40°F (4°C) — SAE 30, 10W30, 15W50, or 20W50
Above 40°F (4°C) — SAE50, 15W50, 20W/50, or 20W60

Sump Capacity – The system has a wet type oil sump with a drain-refill capacity of eight quarts.

Oil Filter – A full flow, spin on-type, 20-micron oil filter is used.

NOTE

There are a number of oil additives on the market that are formulated for automotive use; however, they are not approved for aircraft operations.

BRAKES AND TIRE/NOSE STRUT PRESSURES

Proper inflation of the tires reduces tire external damage and heat, which reduces tire wear. Proper inflation of the nose strut ensures a smoother ride. Maneuverability on the ground is enhanced when tire and strut pressures are at proper levels. The table below (Figure 8-2) summarizes the recommended pressures and types of tires.

Tire Considerations – The airplane is normally delivered with Goodyear tires. These tires have a profile that provides about ⅜ in. (0.95 cm) clearance between the tire and wheel pants. Other brands of tires with similar specifications and TSO's may have slightly larger profiles. Tires with larger profiles are not recommended since damage to the tire or wheel pant is possible, particularly during landing. If other brands of tires are used, the profile of the tire must be precisely measured and compared with the Goodyear tire.

CAUTION

The profile of replacement tires that are not a recommended brand should be measured precisely to ensure they are the same height and width. The use of tires that have slightly larger profiles can cause damage to the tire and to the wheel pant, particularly during landing operations.

ITEM	SPECIFICATIONS	PRESSURE	TYPE OF GAS
Nose Strut	LC-40 NGO	250 psi	Nitrogen
Nose Gear Tire	5.00-5 (10 ply)	88 psi	Air
Main Gear Tires	15x6.00-6 (6-ply)	55 psi	Air

(Figure 8-2)

Normally, a trained mechanic adds brake fluid. However, this is an approved item of preventative maintenance, and servicing by a private pilot who is the owner or operator is permitted. The brake fluid levels shall be serviced according to instructions contained in the *Lancair Columbia 300 (LC40-550FG) Maintenance Manual* with MIL-H-5606 hydraulic fluid.

BATTERY REPLACEMENT CYCLES

The Columbia 300 has three separate batteries that require periodic replacement. While the system battery indicates its charge on the installed voltmeter, the standby and ELT batteries do not have a positive test to indicate their charge. The table below summarizes the replacement cycles.

BATTERY REPLACEMENT CYCLES		
BATTERY TYPE	BATTERY LOCATION	REPLACEMENT CYCLE
Emergency Locator Transmitter (ELT) Battery	Aft of the baggage compartment hat rack – Please see page 7-65 for more information.	Every 2 years (Artex 200), every 5 years (Artex ME406), or when the battery had been used for more than one hour or used 50% if its power
Standby Battery – Lithium Ion Type Battery	Behind the kidney panel on the right side of the instrument panel	Every five years - However, if the battery is activated for any reason, it must be replaced.
System – Dry Sealed Lead-Acid Type Battery	Just forward of the firewall on the copilot's side	Every Four Years – However, if the battery fails to hold a charge, it must be replaced.

(Figure 8-3)

MAINTENANCE AND DOCUMENTATION

MAINTENANCE

Airplane Inspection Periods – Part 91, Subpart E of the Federal Aviation Regulations requires that each U.S. civil registered airplane not used for hire be inspected every 12 calendar months in accordance with Part 43. (U.S. operating rules do not apply in Canada.) If the airplane is used for hire, the regulations require that it must be inspected before or at each 100 hours of time in service.

Airworthiness Directives – The FAA may issue notifications known as Airworthiness Directives (AD's) that are applicable to the airplane or one of its components. The directives specify what action is required and normally have a compliance period. It is the responsibility of the owner/operator of the airplane to ensure compliance with all applicable AD's.

Preventive Maintenance – A certificated pilot who owns or operates an airplane not used as an air carrier is authorized by FAR Part 43 to perform limited preventive maintenance on his or her airplane. (U.S. operating rules do not apply in Canada.) Appendix A of Part 43 of the Federal Aviation Regulations is specific as to what items constitute preventative maintenance. Only the certificated pilot who owns or operates the airplane can perform the specific items listed in FAR Part 43. The work must be performed according to procedures and specifications in the applicable handbook or maintenance manual. Appropriately licensed personnel must perform all other maintenance items not specifically identified in Appendix A of Part 43. For more details regarding authorized maintenance, contact the dealer or service center.

Alterations or Repairs – All alterations or repairs to the airplane must be accomplished by licensed personnel. In addition, an alteration may violate the airworthiness of the airplane. Before alterations are made, the owner or operator of the airplane should contact the FAA for approval.

Required Oil Changes and Special Inspections – During the engine break-in period, straight mineral oil must be used for the first 25 hours. After the first 25 hours of the airplane's time in service, the oil and oil filter must be changed and a new supply of Teledyne Continental Motors specification MHS-24 (latest revision) ashless dispersant oil must be used. At 50 hours of time in service, the oil and oil filter shall be changed and the filter and discarded oil checked for evidence of metal particles. Thereafter, the oil and oil filter must be changed at every 100 hours of time in service.

At the first oil change, the engine and related accessories including the magnetos, starter, alternator, engine driven fuel and oil pumps, oil cooler, propeller governor, and vacuum pumps should be inspected for oil leaks and security. Spark plug leads and other electrical circuits should be checked for proper routing, abrasion, chafing, and security. Check engine controls and linkages for proper operation. Finally, check the intake and exhaust system for security and evidence of cracking.

Recommended Oil Changes and Special Inspections – At approximately every 50 hours of time in service it is recommended the engine oil be changed. Since the cowling is removed for an oil change, a cursory inspection of other engine systems is possible, and the engine can be cleaned and degreased if necessary. The airplane's engine is the single most expensive component in the airplane and arguably the most important. The comparative nominal expense and time involved in doing 50-hour oil changes are more than offset by the long-term benefits and peace of mind.

Warranty Inspections – Please refer to Lancair Warranty Inspection Guide.

AIRPLANE DOCUMENTATION

There are certain items required to be in the airplane at all times. Moreover, some of the items must be displayed near the cabin or cockpit door. The required items are provided with the airplane when it is delivered to the new owner. A description of all required documentation is summarized in the table below in (Figure 8-4).

Item	Must be Displayed	Location
Aircraft Airworthiness Certificate	Yes	In display pocket on the copilot's side near the rudder pedals
Aircraft Registration	Yes	
Pilot's Operating Handbook and FAA Approved Flight Manual	No	All these items are located in the front passenger seatback pocket.
Weight & Balance documentation (FAA Form 337 if applicable)	No	
Equipment List	No	

(Figure 8-4)

ADLOG™ MAINTENANCE RECORDKEEPING SYSTEM (MRS)

The ADLOG™ MRS is included in the airplane's delivery package. Its 12 color-coded, indexed sections simplify, organize, and centralize all relevant airplane maintenance data. The ADLOG™ MRS also includes a one-year airworthiness directive (AD's) revision service for the applicable equipment, instruments, and components for the airplane based on its serial number. Thereafter, the owner of the airplane can continue the subscription at a fairly nominal cost.

This system is the best available and ensures that the maintenance history of the airplane and all applicable AD's are precisely documented in a logical format. The system has been in use for more than 20 years and is revered by both mechanics and Part 135 operators. The ADLOG™ service also includes AD's for STC equipment that the owner may add to the airplane.

HANDLING AND STORAGE

GROUND HANDLING

Towing – A locking, hand-held tow bar is provided with the airplane and stored in the baggage compartment. The tow bar is inserted into two small holes in the nose wheel fairing, forward of the nose wheel axle. The tow bar must be locked in place before attempting to move the airplane.

The tow bar is collapsible for storage by removing the locking pin. With the pin removed, slide the handle out of the sleeve and insert in the opposite end. Reinsert the locking pin. To use the tow bar, reverse the procedure.

It is recommended that the airplane only be maneuvered during towing by use of the hand-held tow bar. If it is necessary to tow with a vehicle, extreme care is required to ensure the rotation limits of the nose wheel (60° left and right) are not exceeded. Since the rotation of the nose gear is limited by physical stops, rotating the gear beyond 60° will damage the airplane.

It is always a good idea to have another person serve as a spotter when moving the airplane. Remember that the airplane has vertical limitations as well as horizontal restrictions. The vertical stabilizer is frequently overlooked as an airplane is being pushed into a hanger with most of the attention directed towards the wingtips. When moving the airplane over uneven surfaces, remember that small up and down oscillations of the nose strut result in amplified movement of the vertical stabilizer. Finally, keep in mind that inflation levels of both the nose tire and strut affect the height of the vertical stabilizer. A flat tire or low nose strut will increase the height of the vertical stabilizer.

CAUTION

Do not attempt to move the airplane by pushing or pulling on the propeller. This a common practice for airplanes with fixed pitch propellers; however, it is not recommended for constant speed propellers, since pressures applied to the propeller blades are transmitted to moving parts within the propeller hub. Over time, these forces could cause damage to the propeller.

Parking – During parking operations, it is best to head the airplane into the wind if possible. Normally, setting the parking brake is recommended; however, there are two situations where doing so is not a good idea.

1. If the brakes are overheated, which might result from a short field landing or extensive taxiing, it is best to not set them until they have had a sufficient cooling period. A brake pad clamped to a hot chrome disc can cause uneven cooling of the brake disc, which has the potential of warping it.
2. It is also not a good idea to set the brakes in cold weather. Accumulations of freezing rain, ice, and snow can freeze-weld the brake pad to the disc. Landing or taxiing in standing water at near freezing temperatures can cause similar problems if the brakes are set when the airplane is parked.

Securing the Airplane – In any event, whether the brakes are set or not set, the airplane should be chocked and the following items should be accomplished to secure the airplane.

1. Install the control lock.
2. Chock the main gear tires with chocks on both sides of each tire.

3. Attach a rope or chain to each tie-down point and secure the rope or chain to a ramp tie-down point. There are three tie-down points, one on each wing and one on the tail. The ropes or chains should have a tensile strength of at least 750 lbs.
4. Install the pitot tube cover.

WARNING

Do not use any device except approved tie-down rings to secure the airplane. While the proper size eyebolt from a hardware store will fit in the threaded tie-down socket, the eyebolt length is critical. A tie-down bolt of incorrect length could cause jamming or interfere with proper movement of the ailerons.

Windshield Cover – The use of a windshield cover is an often-debated issue and is a decision the owner or operator of the airplane must make. Windshield covers have both positive and negative benefits. Ultimately, a number of factors must be weighed, including (1) the geographical area of operations, (2) the time of year, (3) the specific parking location, and (4) the integrity of the covering device.

1. From a positive standpoint, the cover limits the intrusion of ultraviolet (UV) light. Over time, UV rays significantly accelerate the aging process, which makes the windshield and windows more brittle and impregnates them with an irremovable yellowish tinge.
2. On the negative side, dust and dirt can accumulate between the cover and the windshield. When the wind blows, the whipping action of the cover beats the dust and dirt into the windshield.

JACKING AND LEVELING

Jacking – There are two jack points under each wing proximate to the wing saddle. The points are near the center of mass of the longitudinal axis, and great care must be used when jacking the airplane. The tailskid is used as a third point of stabilization. The following points should be considered when the airplane is raised by jacks.

1. If the airplane is simultaneously lifted by both jacks, then specific procedures established in Chapter 7 of the maintenance manual must be followed. This procedure is fairly involved. It requires special equipment to stabilize the airplane, sandbags for tail ballast, and three or four people to operate the jacks and keep the airplane steady.
2. If only one jack is used, as when changing a single tire, the airplane can be safely jacked by one person using the following procedure.
   a. The operation must be performed in a level area, such as an airplane hangar.
   b. Set the parking brake and chock the nose tire and the main gear tire that is not raised.
   c. Place 50 pounds of ballast (usually sandbags) on the engine cowling, near the propeller.
   d. Place a jack under the jack point of the wing to be lifted and raise the jack up to the wing jack point. Take extra precaution to ensure the jack is properly stabilized, the base is locked in position, and the jack is lifting vertically. Be sure the raising point of the jack is properly inserted into the jack point on the wing.
   e. Slowly raise the jack until the desired ground clearance is achieved. However, the clearance between the bottom of the tire and lifting surface (ground or hangar floor) must not exceed three inches.

Leveling – Please see page 6-4 for information about leveling the airplane.

STORAGE

The storage of an airplane mostly deals with engine related items. Very little needs to or can be done to preserve the airframe, particularly for flyable and temporary storage. The best protection for the exterior is, of course, to hangar the airplane, if possible. If the airplane cannot be hangared, then a coat of wax using the material and techniques described on page 8-17 should be applied to all exterior surfaces. In addition, all typical items associated with securing the airplane should be done. These include: (1) installing the pitot tube cover, (2) chocking all wheels and tying the airplane down with the parking brakes released, (3) installing the control lock, (4) topping off the fuel tanks, (5) cleaning the bolts and nuts on the brakes and applying a non-stick preservative like graphite or a silicone, and (6) installing other owner-option protection devices. There are three types of storage categories, flyable, temporary, and indefinite. The time period and applicable storage procedure for each type is discussed below.

Flyable Storage (7 to 30 days) – If the airplane is to be maintained in flyable storage, then it should be flown for a minimum of 30 minutes every 30 days; ground running the engine is not a substitute for flying the airplane. During flyable storage, the propeller should be rotated by hand every seven days. This operation should include at least six complete revolutions of the engine. Stop the propeller 45º to 90º from its original position. For maximum safety use the following procedures:

1. Ensure that the ignition switch is set to the OFF position.
2. Set the throttle to the CLOSED position.
3. Set the mixture to IDLE CUT OFF.
4. Set the parking brake, and chock the wheels.
5. Ensure that airplane tie-downs are secure.
6. Open cabin door on the pilot's side of the airplane.
7. Always assume the propeller could start when moving it manually, and use an appropriate technique for hand turning the propeller.
8. Release the parking brake when the operation is completed.

WARNING

Always assume that the engine could start when rotating the propeller by hand. Remain clear of the arc of the propeller blades at all times.

Temporary Storage (up to 90 days) – Use the following procedures to preserve the engine for temporary storage. See the Airframe Preservation for Temporary or Indefinite Storage heading on page 8-15 for airframe preservation items.

1. Remove the top spark plug from each of the six cylinders, and apply an atomized injection of preservation oil, MIL-L-46002, Grade 1. As the oil is injected into each cylinder, the piston should be near bottom dead center, and the preservation operation should be done at room temperature.
2. When Step 1 is complete, and with none of the pistons at dead center, re-spray each cylinder thoroughly making sure to cover all interior surfaces.
3. Install spark plugs.
4. Spray approximately two ounces of preservation oil through the oil filler tube.
5. Seal all engine openings exposed to the atmosphere with suitable plugs or moisture resistant tape.

6. Tag engine, cowling, and other appropriate areas with the statement, "Do not turn propeller, engine preserved."

Return to Service From Temporary Storage – To return an airplane that has been in temporary storage to active service, perform the following steps.

1. Remove seal plugs, tape, and all methods of tagging the airplane, including items tagged on the airframe.
2. Remove the bottom spark plug from each of the six cylinders, and rotate the propeller several times to remove the preservation oil.
3. Reinstall the spark plugs according to manufacturer's recommendations.
4. Conduct a normal engine start and idle the engine for several minutes until oil temperature is within normal limits. Monitor engine instruments to ensure they are within normal operating ranges.
5. Stop the engine and inspect the entire airplane before test flying.

Indefinite Storage (Over 90 Days) – If the airplane is to be stored for a long period, follow the procedures listed below to preserve the engine. See the Airframe Preservation for Temporary or Indefinite Storage heading on page 8-15 for airframe preservation items.

1. Drain the engine oil and refill with MIL-C-6529 Type II preservation oil. Start the engine and operate until normal temperature ranges are achieved. Fly the airplane for about 30 minutes and then allow the engine to cool to the ambient temperature.
2. Follow Steps 1, 2, and 4 above for Temporary Storage.
3. Install dehydrator plugs MS27215-1 or -2, in each of the top spark plug holes. Ensure the dehydrator plug is blue when installed. Protect and support the spark plug leads with AN-4060 protectors.
4. Place a bag of desiccant in the exhaust pipes, and seal the openings with moisture resistant tape.
5. Seal the induction system with moisture resistant tape.
6. Seal the engine breather by taping a dehydrator plug, M527215-2, in the lower end. Seal the "whistle hole" vent in the breather tube with moisture resistant tape.
7. Tag engine, cowling, and other appropriate areas with the statement, "Do not turn propeller, engine preserved."
8. Install plugs in the engine cowl inlets and all other openings. **Do not plug or seal tank vents on the bottom of each wing.**

NOTE

During the various storage periods, FAA Airworthiness Directives and manufacturer's service bulletins may apply which require action based on calendar dates, not operating hours. These items must still be completed even though the airplane is in storage.

Return to Service From Indefinite Storage – To return an airplane that has been in indefinite storage to active service, perform the following steps.

1. Remove all dehydrator plugs, seal plugs, tape, and all methods of tagging the airplane including items tagged on the airframe.
2. Drain the preservation oil, and service the airplane engine with the recommended lubricating oil.

3. Remove the bottom spark plugs from each of the six cylinders, and rotate the propeller several times to remove the preservation oil.
4. Re-install the spark plugs and carefully rotate the propeller by hand several times to check for possible liquid lock.
5. Conduct a normal engine start, and idle the airplane for several minutes until oil temperature is in within normal limits. Monitor all engine instruments to ensure they are within normal operating ranges.
6. Stop the engine and inspect the entire airplane before test flying.
7. Test fly the airplane.

NOTE

The dehydrator plugs must be visually checked every 30 days to verify that the color has not changed. Bad dehydrator plugs should be replaced. If more than half of the plugs change color, the bad plugs and all the desiccant bags on the engine should be replaced.

Every six months the dehydrator plugs should be replaced and the cylinders re-sprayed with preservation oil. When removing the plugs, check the cylinder interior. If rust stains are noted, spray the cylinder with preservation oil, turn the prop through six revolutions, and then re-spray all cylinders.

Airframe Preservation for Temporary and Indefinite Storage – If the airplane is to be stored for over 30 days, some or all the procedures below may be applicable, depending on the anticipated storage time period.

1. Ensure the tires are free of grease, oil, tar, and gasoline. The presence of these items accelerates the aging process. Sunlight and static electricity convert oxygen to ozone, a substance that accelerates the aging process. Special tire covers can be installed which retard the erosion process.
2. It is best if the weight of the airplane is removed from the tires to prevent flat spots. If the airplane cannot be blocked or set on jacks, then every 30 days each wheel should be rotated about 90º to expose a new tire pressure point.
3. If the airplane does not have a recent coat of wax, a new coat should be applied as discussed on page 8-17.
4. Lubricate exposed exterior metal fittings, hinges, push rods, etc. Use plugs or moisture resistant tape to seal all openings except fuel vent holes and drain holes.
5. Remove the battery and store in a cool, dry location. The battery may need periodic servicing and recharging depending on the storage period.
6. Prominently tag areas where tape and plugs are installed.

Airframe Preservation Return to Service – To return the airframe portion of an airplane that has been in temporary or indefinite storage to active service, perform the following steps, as applicable.

1. Remove all methods of tagging and sealing the airplane including any items on or in the engine area.
2. Remove tire covers or other protection devices. Check the condition of the tires and service to proper pressures. Cracked, deformed, and desiccated tires should be replaced.
3. Thoroughly clean the exterior of the airplane including the transparencies. If necessary, renew the protective wax coat. See page 8-17 for instructions on care of the airframe.
4. Check the condition and charge of the battery. If the battery is still serviceable, reinstall it in the airplane; otherwise, install a new battery.

NOTE

When an airplane has been in storage for a long period, the date of the required annual inspection may have passed. There is no requirement to perform this inspection during the temporary or indefinite storage period. However, the inspection must be completed before than airplane is returned to service.

Inspections During Temporary Storage – The following inspections should be performed while the airplane is in temporary storage.

1. Check the cleanliness of the airframe a frequently as possible, and remove any dust that has collected.
2. Check the condition and durability of the protective wax coat and renew as required.
3. Every 30 days, check the interior of at least one cylinder for evidence of corrosion.

Inspections During Indefinite Storage – The following inspections should be performed while the airplane is in indefinite storage.

1. Check the condition of the dehydrator plugs ever 30 days to verify that the color has not changed. Bad dehydrator plugs should be replaced. If more than half of the plugs change color, the bad plugs and all the desiccant bags on the engine should be replaced.
2. Every six months the dehydrator plugs should be replaced and the cylinders re-sprayed with preservation oil. When removing the plugs, check the cylinder interior. If rust stains are noted, spray the cylinder with preservation oil, turn the prop through six revolutions, and then re-spray all cylinders.

AIRFRAME AND ENGINE CARE

AIRFRAME

Exterior – The exterior painted surfaces are cleaned by washing with a mild soap and water and drying with a soft towel or chamois. The seal coats that are applied to the painted surface, in most instances, will provide adequate protection from moisture and the sun. Some additional protection is provided by waxing the painted surface and facilitates washing the airplane since bugs and dirt will not adhere as tightly to a waxed surface. A wax with a high concentration of carnauba is recommended. There are several commercial boat waxes available that are ideal for this use. Be sure to read the label with an eye for the percentage of carnauba in the compound.

CAUTION

Do not wax the airplane for at least 180 days from the date of purchase. The paint curing process involves the expulsion of certain substances within paint. A coat of wax can impede or stop the curing process, which inhibits adhesion of the paint to the composite surface.

The exterior paint color on the upper fuselage area and the top of the wings has a good heat reflection index. This good index is required to ensure the continued bonding and integrity of the composite material. Only approved Lancair paint colors are permitted in these areas. Care must be taken to not lay dark, heat absorbing material on the top area of the wings and fuselage.

Anti-erosion Tape – The anti-erosion tape is located on the leading edges of the wings, horizontal tail, vertical tail, and gear fairings. Care should be taken to prevent damage to the tape on the wing when entering the aircraft. People who sit on the wing by lifting themselves up over the leading edge should take care not to drag their legs over the tape when sliding on or off the wing. If the tape is starting to fray, detach, crack, crinkle, etc., it should be replaced using the instructions in the maintenance manual.

Windshield and Windows – The proper care of the windshield and windows (sometimes referred to as transparencies) is one of the more important exterior care items on the airplane, and often the least understood. The cardinal rule is never do anything that will scratch the surface of the acrylic plastic. The following points for cleaning and caring for the transparencies will help to keep windows looking and performing like new.

1. First, when cleaning the windows, it is recommended that rings and watches be removed as they can cause deep scratches. In this vein, long sleeve shirts should be turned up a few rolls to hide exposed buttons.
2. When removing bugs and dirt, avoid touching the surface. If possible, remove most of the dirt by flushing the windows and windshield with water and a mild dish soap mixture. Allow the accumulation of dirt and/or bugs to soak for a few minutes. If rubbing is required, a bare hand is best. When all the debris on the surface of the window is loosened, apply a second water flush and then dry with a 100% cotton cloth.
3. Use a good quality non-abrasive cleaner/polish specifically intended for acrylic windows and apply per the manufacturer's instructions. Use up and down or side to side movements when polishing. Never use a circular movement as this can cause glare rings.
4. The best polishing cloth is the softest cotton available. One hundred percent cotton flannel is ideal and available in yard goods stores. **Never use** any type of paper product or synthetic material. In particular, never use shop rags or shop towels. Be sure the polishing cloth is

clean and dry. Reserve polishing cloths should be stored in a plastic bag to limit dirt accumulation.

5. Small scratches, the type that can be seen but cannot be felt with a fingernail, should be filled with a polishing compound that has scratch filling properties. The cleaner/polisher mentioned in paragraph 3 frequently has scratch filling properties and is satisfactory for regular use. Some scratches are not correctable with a scratch-filling product. While the scratches cannot be felt, they are still visible, particularly when flying into the sun. In this instance, a mildly abrasive scratch removal cream can be used per manufacturer's recommendations. Scratches of greater magnitude require the use of high abrasives and removal of some of the window's surface around the greatest depth of the scratch. This procedure requires considerable expertise and frequently makes areas where the scratch was removed more objectionable than the original scratch.
6. As mentioned previously in this section, the use of canopy or window covers can grind dirt particles into the acrylic and are virtually impossible to remove.

CAUTION

Do not use anything containing ammonia, aromatic solvents like methyl ethyl ketone, acetone, lacquer thinner, paint stripper, gasoline, benzene, alcohol, anti-ice fluid, hydraulic fluid, fire extinguisher solutions, or window cleaner on the acrylic window surfaces. The use of these substances may cause the surface to craze.

NOTE

To remove difficult substance such as tape residue, oil, and grease, the safest solvents are 100% mineral spirits or kerosene. Some alcohols are safe, such as isopropyl alcohol.

Interior Cleaning and Care – The useful life of the airplane's interior can be extended through proper care and cleaning. One of the major elements in the aging process is the interior's exposure to sunlight. If possible, the airplane should be hangared. Routine vacuuming is another item that helps extend the life of the airplane's interior. A general rule for spills is to blot the affected area with firm pressure for a few seconds. Never rub or pat an area to remove a spill.

Portions of the airplane's seats are covered with leather. The leather is treated with a sealant, which provides a protective cover. Do not attempt to feed the leather in any way. In particular, the use of spray polishes, saddle soaps, waxes, and so-called hide foods create a sticky surface, which attracts dirt and can cause irreversible damage.

The leather and ultra-leather seats, seatbacks, knee bolsters, and the like, should be routinely wiped with moist soft cotton cloth after vacuuming. Use a mild non-detergent soap such as Neutrogena. Wipe the leather and ultra-leather using a light circular motion taking care not to soak the surface. Once the seats and other areas are clean, repeat the process using clean water and then wipe the surfaces with a dry cloth. For ink stains, use a special application available through Douglas Interior Products known as a D.I.P. Stick. Since the D.I.P. Stick application must be used within 24 hours, one should be held in reserve at all times.

The carpet can be cleaned with a mild foam product, but care must be used not to over saturate. Follow the manufacturer's instructions regarding use of the foam cleaner. Small spots can be cleaned with a commercial spot remover; however, this must be done with care. Again, follow the recommended procedure of the manufacturer, and try a test application in an area of limited exposure.

ENGINE AND PROPELLER

Engine Cleaning and Care – If necessary, the engine is normally cleaned at the recommended 50-hour oil change interval since the cowling is removed to change the oil. In addition, the air filter should be cleaned at every 100 hours of time in service; it may require more frequent cleaning depending on the operating environmental conditions. If the engine is cleaned at the 50 or 100 hour oil change intervals, this should be adequate under most operating conditions.
In any event, the engine must be kept relatively clean for all flight operations. It is difficult to establish a precise time in service recommendation since much depends on the environmental conditions and the types of airplane operations. Engine cleaning, air filter cleaning and replacement, and lubrication of the engine controls is permitted as an item of preventative maintenance and can be performed by the owner or operator if that person possesses a private pilot or higher level of certification.

It is best to clean the engine with a spray type cleaner, preferably under pressure. There are a number of approved commercial solvents specifically designed for this use. Care must be exercised to ensure that application of the solvent does not damage other components in the engine area. Refer to the *Lancair Columbia 300 (LC40-550FG) Approved Maintenance Manual* for additional instructions.

Propeller Cleaning and Care – It is important to keep the propeller clean since it facilitates detection of cracks and other problems. The propeller must be cleaned with a non-oil-based substance such as Stoddard Solvent. The solvent must only be applied to the surface of the blades with a soft brush or cloth; care must be used to avoid contact with the propeller hub and seals. Do not use any type of spray application, pressurized or unpressurized, since over-spray particles could contact the propeller hub and seals. The use of water and a mild soap is also acceptable; however, never use any alkaline-based products.

Nicks on the leading edge of propeller blade, particularly towards the blade's tip should be dressed out as soon as possible. Undressed nicks, over time, can lead to problems that are more serious. The repair of the airplane's propeller, including propeller nicks, can only be performed by authorized maintenance personnel and is <u>not</u> an item of authorized preventative maintenance.

When the propeller is clean, dry the surface with a soft cloth and wax the blades with a good quality automobile paste wax. The major issue with propeller care is corrosion control. Frequent cleaning and applications of paste wax will significantly retard the erosion process. These procedures are particularly applicable in geographical areas of high humidity and salt particles. Never try to remove corrosion pitting with an abrasive material such as steel wool or sandpaper since this accelerates the corrosion process.

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